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THE COMPLETE PHOTOGRAPHER

*A Complete Guide To
Amateur And Professional
Photography*

WILLARD D. MORGAN, GENERAL EDITOR

33221

VOLUME TWO

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FOREWORD

ANYONE who attempts to analyze the photo mind of America must have an abundance of facts at hand. Such information must be backed up by personal contacts with thousands of photographers. I do not think that any one person can come forth and say that any particular trend in photography is the only thing to follow.

The minute any group of photographers become static in their photographic thinking, there is another group in reserve which quickly by-passes and goes ahead with new stimulating ideas. The sure proof of this clashing of ideas and interlocking of photo horns is in evidence all about us. A certain type of pictorialist is adamant in his inflexible stand against changing photographic principles which have been handed down from past decades. There is still the hangover of many 19th Century ideas in this field. On the other hand, there is the progressive or liberal type of pictorial photographer who is endeavoring to change these old rules and give this type of picture-making a fresh impetus with stimulating ideas and a more tolerant viewpoint. Other clashes in photo ideas come between the so-called documentary type of photographer and the maker of pretty pictures. In other words, it is the contrast between sharp reality and a misty waterfall. Here again I feel that each group may misunderstand the other.

Basically, photography is undergoing one of its greatest upheavals at the present time. As we enter a second century of photographic progress, there are so many new challenges for each one of us that it is high time that the hardening of the arterial minds of some photographers be subjected to modern treatment. This does not mean that every one must abandon his past habits and beliefs. On the contrary, I feel that we can all profit by readjusting ourselves to a new world of international thinking which is now at hand. In doing this, we can read stimulating books and accounts dealing with important world subjects. Then, there are great photographs appearing in our publications which deserve special study. Probably we should become more aware of how our country is operated through many intricate channels. Such study will lead us to a better understanding of how photographers as a group and also as individuals, may learn to see important photographs in their own localities.

The happy contented expression of a youngster can easily reflect the state of the nation just as much as a photograph of a political rally. Photography is continually going through interesting transitions. Within the last 15 years, for example, most of us have witnessed many of these changes. Ten years ago every other photograph seemed to be pointing up into the air and showing toppling smokestacks, reeling skyscrapers, and other fantastic distortions which gave us the great period of earthquake perspective. This period was naturally overdone and it has evened off to find its own level in the modern photographic stream. Then, we had another upheaval of candid photography which was introduced with the miniature camera. Here again our publications and private snapshot files were packed with grinning, sneezing and lurid faces undergoing all types of contortions. I am sure that we all had fun discovering these new viewpoints and uses for our miniature cameras. However, this phase has entered into a more matured type of candid photography. This came with the popularizing of the picture series during the last few years. Instead of seeing an isolated candid expression of some politician, we now learn to become acquainted with him through a dozen pictures, each one of which reveals a definite part of his life.

More drastic changes can be compared with a modern portrait and a portrait taken 25 years ago. Today all the florid backgrounds have disappeared. In their place, we have either a plain background or a portrait showing a personality in his own natural environment. An author might be working over his manuscript, a businessman's portrait may have some relation to his work. Again, the heavily retouched photograph which eliminates all character lines is going through quick changes. This has undoubtedly been influenced by many of the news photograph-

ers who give us the picture of a person straight from the shoulder without any retouching. In fact, there is no time in news work for intricate retouching and changing character lines in faces which a lifetime has put there.

Photography has assumed an enviable position by itself quite different from all other graphic arts. Today it is up to you and me to carry on this great heritage which has come to us through a century of technical developments. We now have the best equipment available. It is the duty of every photographer to enter into this modern spirit of photographic learning and tolerance. There is really no place today for the individual with a spherical aberration mind who revolves within his own selfish circle and completely ignores the rest of humanity. I have included many articles in *THE COMPLETE PHOTOGRAPHER* which point the way for obtaining this broader understanding. All I ask is that each reader study them and avoid too hasty criticisms without actually trying out many of the ideas proposed.

After working with photographers for over 15 years, I feel that the worst blockade for the development of many individuals has been their own inflexible attitude toward photography and its social relationships. By this I mean that a photographer will rigidly adhere to certain finishing technics, specialized ideas in composition, and show a super inflexibility towards photographing certain subjects. This type of photographer would never show a so-called unpleasant scene. He would rather close his eyes to realities all about him. Instead of showing how people really look and live, he may place them in an artificial environment and eliminate all character influences through soft focus, retouching, and allow the person to assume a fixed unemotional stare before the camera. On the other hand, the person who can understand people will always be on the alert to watch for those expressive transient moods which mean so much in everyone's life. He will interpret the hopes of youth or show through his lens the fine features of some great scientist. Right here is the greatest keyboard of modern photography. It is the interpretation of people.

Too many photographers have built up a Maginot line of defense which is easily left behind when new groups of individuals forge ahead with their ideas. Such conditions give photography its greatest impetus for creative work. At present this group of thinkers represents a small percentage of all workers. However, these small groups exert a tremendous influence upon 25,000,000 photographers who are actively photographing today. For example, a small group of miniature camera enthusiasts changed the habits of static news photographers between 1930 and 1935. As these newsmen learned how to apply many of the interpretative candid principles which were, in many cases, developed by amateur photographers, we found the complete turning point in photo-journalism starting about the end of 1936. From then on the picture magazines began sprouting and revealing endless examples of this new photo change. In turn these original publication photographers had a marked influence on photographers in general.

Similar instances can be revealed through the entire development of photography. It is always an individual or small group which starts out exploring new photographic highways. These are the creative workers who will help carry photography on to greater importance during the coming years. In the meantime the laboratory technicians are striving every day to perfect better lenses, finer grain emulsions, faster emulsions, more efficient lighting equipment, and many other photo accessories which are utilized as fast as they appear. Such progress, ranging from the mechanical technic to the creative photographer, is actually a challenge to each one of us. We can all enter into this new creative excitement and produce great pictures which will stand out with significant importance for our time.

WILLARD D. MORGAN.

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secret, the work was difficult. It was brought to a successful conclusion in 1915 and processes and materials were greatly improved when silicate chemists of the Geophysical Laboratory of the Carnegie Institution gave their aid during World War I.

Although limited production was begun in other plants during the war these were discontinued after the emergency, while Bausch & Lomb embarked on extensive experimental work to improve glass technology and develop additional types of optical glass. Although this has been expensive, the work has been fully justified not only in the exact control this affords Bausch & Lomb as a maker of some 4,000 different optical instruments but in serving related industries and the armed forces of the United States.

Some fifty types of optical glass are produced by Bausch & Lomb, many of which are necessary to the various multi-element types of photographic lenses made today. Some lenses fulfill special requirements, such as speed, flatness of field, reserve covering power, freedom from distortion, from coma, from astigmatism, and from color aberrations. For this reason many types of photographic lenses are made by Bausch & Lomb to meet the requirements demanded.

BAUSCH & LOMB PHOTOGRAPHIC PRODUCTS

Tessar Lenses, Series Ic, f/4.5

Tessar Lenses, Series IIB, f/6.3

Protar Lenses, Series VII, f/12.5

Convertible Protar, Series VIIa, f/6.3, f/7.0, f/7.7

Protar, Series V, Extreme Wide-Angle, f. 18

Aero Tessar, Series Ic, f/4.5

Process Apochromats, f/10

Baltar, 35mm Motion Picture Lenses, f/2.3

Metrogon, Wide Field Aerial Lenses

Cinephor and Super Cinephor Projection Lenses

Stereoscopic Mapping Projectors and Reduction Printers

Photomicrographic Cameras and Equipment

Ortho-Stereo Camera and Viewer

This list, including only Bausch & Lomb photographic products, is being added to constantly and is subject to change.

BEGINNER'S GUIDE TO DEVELOPING AND PRINTING

John Adam Knight

Photography Editor, New York Post

This is a step-by-step description of how to develop negatives, how to make contact prints and enlargements. Beginners will find an invaluable guide on how to choose the paper, time the exposure, make a darkroom, buy equipment. They are told how to fix and dry prints and negatives. And a questions and answers section takes care of many of the average beginner's doubts. Required reading and a good laboratory manual for all amateurs.

See Also *Bromide Papers and Printing, Contact Printing, Developers, Developing Films, Drying Negatives and Prints, Enlargers and Enlarging, Fixing and Fixation*

THE EVOLUTION of a photograph from unexposed film to finished print on paper consists of two processes.

The first of these is the converting of sensitized film into a negative, which is a translucent image of whatever was in front of the lens when the camera was operated. This image is reversed; that is, the parts of the original scene which were black are clear on the negative, and vice versa. This process is called *developing*.

In the second process, this negative image is transferred to a sheet of sensitized paper on which it is again reversed so that its tonal values become the same as those of the original scene. That is, whatever was black in the original will be black in the finished photograph, whatever was white will be white, and intermediate tones and colors will appear as corresponding shades of gray. This process is called *printing*, and is subdivided into *contact printing* and *projection printing*, the latter usually called *enlarging*.

In essence, the two processes are exactly the same, though the technics employed vary.

The principal difference is that in the first process, the medium is a thin sheet or film of cellulose which has been sensitized by being coated with a thin layer of silver bromide or chloride particles, called grains.

In the second process the medium is a piece of white paper likewise sensitized by being coated in the same manner with the same substance.

BEGINNER'S GUIDE TO DEVELOPING AND PRINTING

These silver grains are held in place by a thin film of gelatin which also binds them to the cellulose base. This is the *emulsion*.

The first step in each process is to expose this emulsion to rays of light. The stronger the light at one particular point, the deeper its rays penetrate into the emulsion, and therefore the more grains of silver it affects. All grains so exposed and so affected undergo an invisible change which permits them to be converted into corresponding grains of metallic silver when immersed in certain chemical compounds known as *developers*.

The next step, then, is development, by which the exposed (and only the exposed) grains of silver bromide or chloride are converted into black, opaque, metallic silver, leaving the unexposed grains in their original state.

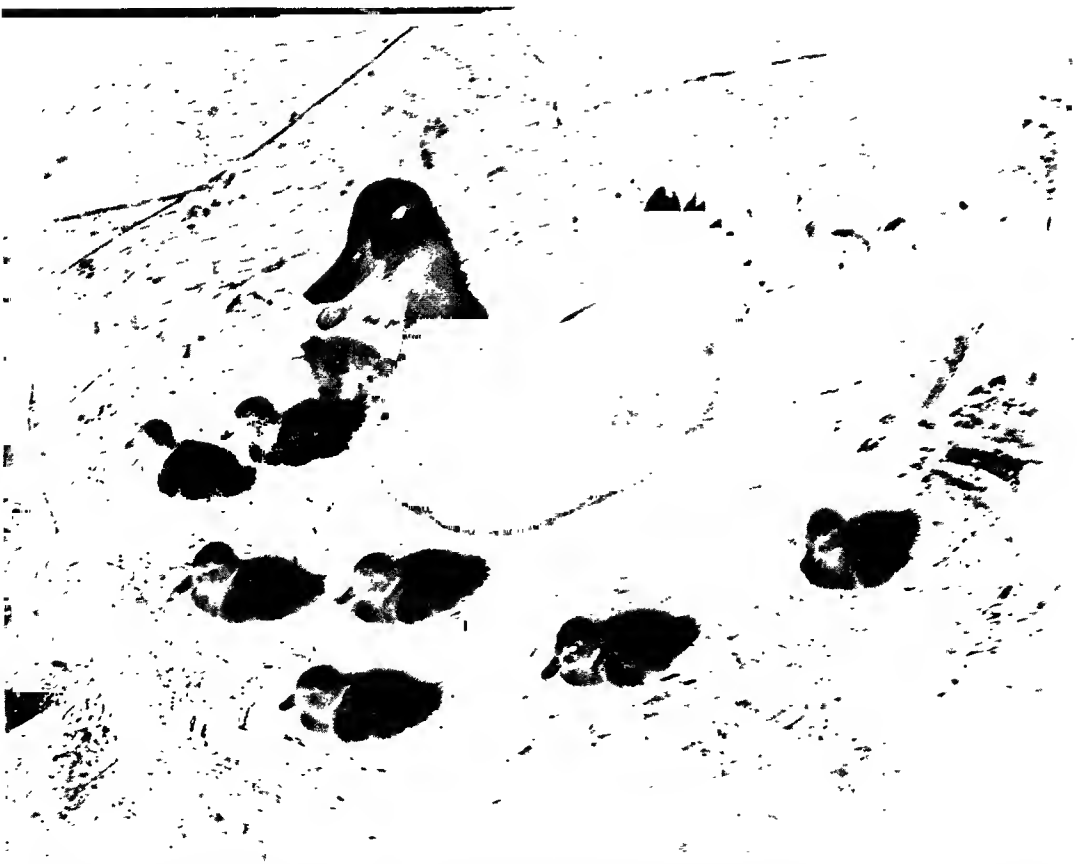
In the next step the developed film or paper is *fixed* in another chemical solution,

which dissolves away all the unexposed, and therefore undeveloped, grains.

The residue of the processing chemicals is then washed out of the film or paper. It is allowed to dry, and the finished product then is known as a negative, if the operations have been performed on film, or a print, if paper was involved.

There is one other fundamental difference in the two processes, however, and this is that while printing and enlarging can be performed by the light of photographic safe-light lamps, it is necessary to perform some of the essential operations of developing in darkness, without seeing the changes take place.

For this reason, and for one other, it is advisable for the beginner to master the second operation before attempting the first. In other words, it is better to learn printing, which can be seen at all stages,



FIRST SWIMMING LESSON. Subjects such as this—newly hatched ducklings getting their first swimming lesson—are everywhere. The beginner must, first of all, be able to see a picture when it is staring him right in the lens
Photo, Percy T. Jones

before starting to do developing, some operations of which must be performed in darkness or in covered vessels.

The other reason is perhaps more important still: a print spoiled by a mistake in technic can be discarded and made over and over until a satisfactory print is achieved. A roll of films ruined in development is ruined forever, and nothing can be done about it.

The best practice, therefore, is for the beginner to have his films developed by a commercial photo-finisher at the start, and to make his own contact prints or enlargements from these negatives. By the time he has learned to make a good print he also will have learned what qualities are desirable in a negative, and this will help him enormously when he goes back to negative processing.

I. TWO PRINTING PROCESSES—CONTACT AND PROJECTION

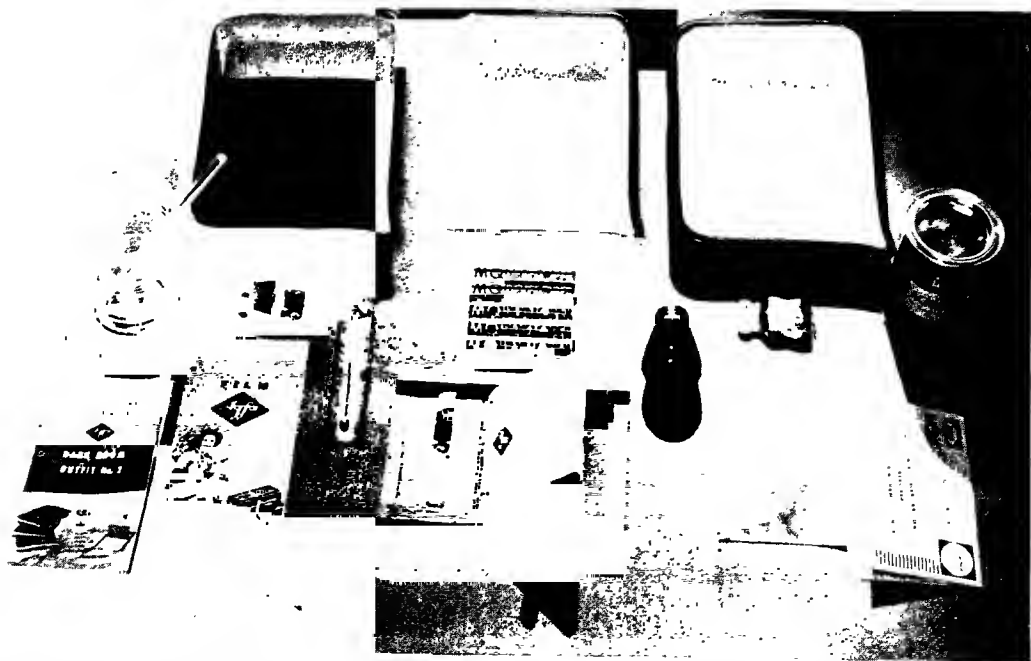
Contact prints are made by permitting light to shine through a negative onto a piece of sensitized paper held in contact with the negative. Thus negative and print are of the same size.

This process is commonly employed by commercial photographers who work with large negatives—from 4 x 5 to 11 x 14 inches—but is seldom satisfactory for amateurs whose cameras make negatives in the smaller sizes. In order to produce prints large enough for exhibition or convenient viewing, it is necessary to make enlargements.

MATERIAL FOR CONTACT PRINTING

To make contact prints, the following material is suggested:

1. One safelight lamp
2. One printing frame, or one printing box, commonly called a contact printer
3. Three trays, each somewhat larger than the prints to be made
4. One tray for washing, at least four times as large as the prints
5. One or more packages of paper of the correct size
6. One bottle or package of developer
7. One bottle or package of acid fixing bath
8. Some acetic acid, 28% solution
9. A glass measuring graduate, 8 ounces or larger



DARKROOM OUTFIT. Everything the beginner will need is shown here. At the top are 3 trays—for developer, acetic acid, and hypo fixing bath; at the bottom is a simple contact printer, shown from the back side. Also shown are: glass graduate with glass stirring rod, film clip, thermometer, developer tubes, safelight, can of hypo

10. Ferrotype tins, if glossy prints are desired, or several clothespin-type photographic clips, if dull finish prints are to be made

11. One squeegee or print roller

12. Two pairs of print tongs

13. One stirring rod

14. A photographic tray thermometer

15. An interval timer or a clock, with sweep second hand

A 7½ or 10-watt red or amber bulb can be used as a safelight for contact printing but is not recommended as the appearance of prints under such light is deceptive. The best light is a yellow-green Wratten OA safelight, and it should be used only with the bulb specified in directions which come with it, and at the recommended distance from the developing tray.

A printing frame is a wooden frame with a glass in front, much like a picture frame. But instead of enclosing a picture, it has a removable, collapsible wooden back, covered with felt and held in place against the glass by a spring.

A contact printer is a wooden box with a glass top, the latter usually measuring 4 x 5 inches for amateur work. Beneath this is a diffused electric bulb of about 25 watts and, usually, a very small red bulb. On top and covering the glass when in use is a spring top similar to the spring back of the printing frame. On some models this top actuates a switch which turns on the light and begins the exposure as it is pressed down into place, and turns off the light when lifted.

The three trays for developing and the larger one for washing may be of stainless steel, enamelware, or hard rubber. The latter are generally more satisfactory, since they are cheap, chip-proof, and noiseless. For prints 4 x 5 inches or less, the 3 small trays should be 5 x 7 inches, the washing tray 8 x 10 or 10 x 12.

Any standard brand of sensitized paper—chloride, for contact prints only—will serve, and the initial order should be for one dozen of grade No. 2, and one dozen of grade No. 3. The meaning of these classifications will be explained presently.

In the envelope with the paper (which should be opened only in a room or closet to which no light is admitted except that from

a photographic safelight) will be found a printed slip with directions for using it, including a recommendation as to the developer to be used. These directions should be followed to the letter. Developers can be bought ready mixed, in powder form, needing only the addition of water for use, or can be mixed at home. The formula is usually included with each envelope of paper.

The acid fixing bath should be the one specified in the directions that come with the paper. It, too, can be bought as ready-mixed powder, or can be compounded at home according to the formula supplied with the paper.

Acetic acid can be bought in 1- and 5-pound bottles, either already diluted to a 28% solution, or full strength. The latter is known as glacial acetic acid. To make a 28% solution, add three parts of glacial acetic acid to eight parts of water.

MAKING A DARKROOM

All light should be excluded from the space to be used as a darkroom. This can be done by covering the windows with heavy, opaque drapes, or cutting pieces of cardboard or plywood to fit over the panes of the windows. If the room is to be used permanently for photographic work only, the windows can be painted with black or metallic paint to exclude light.

Keyholes should be stuffed and weather stripping tacked around the edges of doors where light leaks through.

To test the safety of a room, close all doors and turn off the light for 5 minutes, giving the eyes time to become accustomed to the darkness. If at the end of this period, no single gleam of light can be detected, the room is safe for photographic processing.

The room chosen as a darkroom should contain running water if possible. A kitchen, bathroom, or pantry may be used at night but in this case the floor and tables should be covered with old newspapers to guard against stains caused by photographic solutions.

SETTING UP FOR WORK

On a table or bench, set up the 4 trays, with the large one on the right.

Into tray No. 1 at the extreme left, place a sufficient quantity of developer, mixed according to directions, to cover several prints.

Into tray No. 2, second from the left, pour 16 ounces of water and add to this, $\frac{3}{4}$ ounce of 28% glacial acetic acid.

Tray No. 3 should be filled about $\frac{3}{4}$ full of acid fixing solution mixed according to directions.



CONTACT PRINTING. The author is demonstrating the proper position of contact printing apparatus. In real contact printing work the white light is turned on only for the exposure and the sole illumination is a safelight
Photo, Gorska-Hill

Tray No. 4 should be filled with fresh water, and should be placed in the sink under running water if this is available in the dark-room.

All these solutions should be kept at the same temperature, between 65° and 70° Fahrenheit. In the summer it may be necessary to place the smaller developing trays in larger pans or trays filled with water of the desired temperature.

Use the thermometer often and conscientiously because it is the key to successful processing technic.

When everything is in readiness, turn on the safelight and turn off the room light. Then test the safelight. To do this, open one envelope of paper, take out one sheet, close the envelope, and place it where it will be safe from splashing water and chemicals. Be sure your hands are dry and clean before touching sensitized paper.

Next, place the one sheet of paper, emulsion side up, on the workshelf near the No. 1 tray, in a position where it will not be shaded from the safelight. Place a coin on the paper and let it lie there for five minutes by the clock.

At the end of this time, remove the coin and immerse the paper in the developer (tray No. 1) for 1½ minutes. If the paper turns black or gray, with a white spot where the coin was, the light is not safe and should be changed or moved farther away until a piece of paper so exposed and developed will remain white all over, with no indication of where the coin was.

The emulsion side of the paper sometimes can be told by a slight curl, always toward the emulsion. If there is no curl, running the fingers over each side will reveal which is plain paper and which is coated with a chalk-like substance.

CHOOSING THE PAPER

Contact printing paper comes in 5 or more grades and must be chosen to correspond to the negative from which a print is to be made. This is the most difficult step in the entire process for the beginner to learn, but once the basic principle is grasped everything else is easy.

Examination of an average roll of negatives will reveal that some of them contain areas of almost completely clear film, representing (since the values of the negative image are reversed) deep shadows in the scene originally photographed. The same negative will be found to contain other areas of almost solid black silver, through which the eye can see nothing. These represent extreme highlights in the original subject, and obviously this wide difference in tones makes this a *contrasty or hard negative*. As an example of a subject from which a hard negative inevitably would result, imagine a bride in a gown and veil of pure white, and her bridegroom dressed in a black suit—both against a black background.

Among the other negatives in the roll there may be one taken on a dull, overcast day, of subject matter all of much the same color or tonal value, such as a weather-beaten barn against a background of leafless trees in winter, with a gray, sullen sky

behind it all. This negative will show very little difference between the shades of gray made by its pattern of silver grains. Barn, trees, and sky will appear to be of about the same density when the negative is held up to a light. This is a *flat or soft negative*.

Half way between these extremes will be found negatives of normal contrast, wherein the relationship of the brightest highlight (densest area of the negative) and the deepest shadow (clearest area of the negative) are sufficiently pronounced to give the eye a quick and pleasant impression of the scene, yet not so far separated that the impression is one of harshness and disagreeable contrast. This is a *normal negative*. A normal negative, printed on normal (No. 2) paper will produce the most pleasing and satisfactory print. But, obviously, all negatives will not be normal. Therefore a method of compensating for their deficiencies has been evolved through the use of papers in which the potential tonal scale is compressed or expanded to produce nearly normal prints from negatives varying widely from the normal scale of contrast.

If a negative of extreme contrast were to be printed on a normal paper, it would require long exposure for the light to penetrate through the dense areas of the highlights and register their detail on the paper. In the meantime the light would literally have flooded through the almost completely clear areas representing shadows, and these would appear on the print as solid black, without any of the detail in them being recognizable. Therefore the manufacturers have created papers with emulsions almost incapable of printing solid black in the shadows. These papers may, therefore, be exposed long enough to print through dense highlight areas in the negative without completely destroying detail in the shadows.

Simplified as it is, this explanation may still be difficult for the beginner to understand, and it is not at all necessary that he understand it in order to choose the correct grade of paper. He need only remember the following things:

A hard (contrasty) negative must be printed on soft (No. 1) paper for best results.

A soft (flat) negative must be printed on hard (No. 4 or No. 5) paper.

A normal negative must be printed on normal (No. 2) paper, and a negative only slightly soft must be printed on medium-hard (No. 3) paper.

If in doubt as to which grade is called for, make prints on two or more grades of paper and see which comes out best.

THE EXPOSURE

Now back to the mechanics of contact printing.

Having selected a negative and decided which grade of paper is required, withdraw a single sheet of paper from the envelope, replace the rest and make sure the envelopes and wrappings are light-proof.

On the inside surface of the glass of the printing frame, which should be lying face down with the back removed, place the negative, with its emulsion side up. This can be determined by holding the negative up toward the light and looking at its surfaces obliquely. The emulsion side will appear less shiny than the other. Also, any letters or figures in the negative will read backward when the emulsion side is turned toward the viewer.

On top of the negative on the glass, the sheet of sensitized paper is now placed, with its emulsion side down—against the emulsion of the negative. Now replace the back of the frame, secure it in place with its spring, and turn the closed printing frame face up.

Next, leaving the printing frame face up on a flat surface and using an extension cord, hold an unshaded 25-watt frosted bulb 10 inches over the center of the printing frame and turn it on for exactly 12 seconds, timing it accurately with a timer, or by watching the second hand of the clock. If an extension light is not available, then the frame should be held up to a drop light—same distance, same time.

To prevent "hot spots" which may occur opposite the filament of the bulb, it is advisable to move either the light or the frame about slightly and continuously during exposure.

At the end of 12 seconds, turn off the white light and continue operations by the safelight, which has been allowed to continue burning throughout.

THE COMPLETE PHOTOGRAPHER

DEVELOPING PROCEDURE

Remove the exposed paper from the frame and with one swift motion, slide it into the tray of developer, face up, so that it is completely covered with solution. At the same time, start the interval timer, or observe the clock and begin counting off the time. The paper should be kept in the developer for the exact length of time specified on the direction sheet, usually 90 seconds. During this time the developer tray should be rocked gently to and fro, so that fresh developer is forced across the surface of the print at frequent intervals.

The photographic image will begin to appear on the paper soon after it is immersed in the developer and then, right before the eyes, it will bill out and become embellished and enriched with all the delicacy of tones and detail characteristic of this method.

If the picture begins to grow too dark there will be a temptation to pull it out of the developer right there and then, but *this should never be done*. Neither should a faint print be left in longer, in the hope of further darkening. Developing time is absolute and constant. Variations are brought about by readjustments in exposure.

At the end of the prescribed developing period, lift the print out of the tray by one corner, using a pair of print tongs marked "Developer," which should be used in this tray only, and never confused with tongs marked "Hypo," which are to be used in handling prints in the fixing bath, commonly called hypo by all photographers.

FIXING

Lifted out of the developer by one corner, the print is allowed to drain for an instant, then transferred to tray No. 2, containing



SEVEN MONTHS OLD. One of the first aims of any photographer is to picture the family's pride and joy. Pictures such as this indoor shot of a playful baby are born of careful lighting and exposure, but correct development and printing play a large part in the ultimate success of a photograph

Photo, John Hatlem

the acetic acid solution, called the stop bath. This weak acid solution stops the action of the developer and neutralizes whatever developer remains in and on the print. If this intermediate wash were omitted, the residual developer in and on the print would soon break down the hypo bath, leaving it too weakened to do its work and causing streaks and stains on the print.

A brief rinse of five seconds or so is all that is necessary in the stop bath and the print is then transferred to the hypo, using the other pair of tongs for this purpose. It should be completely immersed in the solution and, face up, moved about for a few seconds at the start, to break up any air bells. These are tiny bubbles of gas forced out of the emulsion by the entrance of the strong acid fixing bath. If not broken up by agitation they will prevent the hypo from acting on the print at the points they cover, thus causing spots on the finished print. A print should be fixed—that is, left in the hypo—about 20 minutes when the solution is fresh and full strength. After use, more time will be required for complete fixing and hardening, but this should never exceed 30 minutes.

After 3 minutes in the hypo it is safe to remove a print, wash it off in the wash tray or under running water, and examine it briefly by regular room light. And this is what should now be done with this first test print, exposed 12 seconds at 10 inches to a 25-watt bulb. Turn on the room light and examine it critically. If it is too dark, you will know that it was exposed too long, and should be made over at, say, 8 seconds. If it is then too dark or too light, a third print should be made with the necessary adjustment in exposure time.

The same applies if the first print is too light. Give the second one 16 seconds exposure, and from this the final, correct exposure can be judged.

WASHING

When a correctly exposed print has been obtained, complete the fixation—20 minutes in the hypo—then rinse it off under running water, if possible, and place it in the wash tray. Where running water is available, this should be allowed to flow through the tray

for 1 hour, and prints should be kept separate from each other, when several are being washed at once.

A siphon device may be bought to keep the water level below the top of the tray, so prints won't float out, and to remove the water from the bottom of the tray, where freed hypo collects.

When running water is not available, prints may be washed by allowing them to soak for 5 minutes in each of at least 15 changes of water, moving them about in each fresh bath to prevent one print from covering another and thus preventing penetration of the chemical-soaked paper and emulsion.

DRYING AND FERROTYPING

When prints are completely washed they should be removed from the tray, swabbed off with a piece of cotton soaked in clean water to remove scum, and placed between two lintless photographic blotters for a minute or two to remove excess moisture. Remember, ordinary blotters will not do—only special photographic ones.

If glossy paper has been used and glossy prints are desired, they are placed face downward on clean ferrotype tins and a print roller or squeegee is used to force them into firm contact with the tin, and to remove air bubbles and water. The tins are then placed, face up, in a warm but not hot place. The prints will dry in from 1 to 6 hours, depending upon temperature and humidity. As they dry they will release themselves from the tins.

When dull (matte or semi-matte) paper has been used, the print is removed from the blotters, a wooden clip attached to one corner, and the whole thing hung up to dry in a warm, dust-free room or closet. The bathroom is ideal. Another and perhaps better way is to construct a frame about 3 feet square, and cover it with cheesecloth. Matte and semi-matte prints may be dried without excessive curling by placing them face downward on the cheesecloth.

Single-weight paper curls much more than double-weight, and costs so very little less that it is generally advisable to use double-weight. When prints curl too much, they can be improved by moistening the backs

(only) and placing them between photographic blotters, then allowing them to dry overnight under strong pressure or the weight of several large books. Special presses are made for this purpose.

USING THE CONTACT PRINTER

Making prints with a contact printer varies from this procedure only in minor details.

scribed, on top of the negative, with the emulsion of the paper in contact with the emulsion of the negative.

Make the exposure by lowering and locking the collapsible top, using the handle provided. Exposure will vary according to the size and type of bulb in the printer, density of the negative, and grade of paper. Six seconds will serve as a starting point for tests with a 4 x 5 printer. All other steps in the use of a contact printer are the same as when using a printing frame.

MATERIALS FOR ENLARGING

Obviously, to make enlargements, the first thing needed is an enlarger. These come in two types, designated as *condenser* and *reflector*, the difference being in the light system.

In condenser enlargers, diffused light is collected by one or two condensing lenses and projected downward through the negative to the enlarger lens in a more or less straight line. This produces prints with sharp detail and distinct tonal separation, and enlargers of this type are generally preferred for negatives $2\frac{1}{4} \times 3\frac{1}{4}$ inches or smaller.

In a reflector enlarger, the light passes through a diffusing screen to the negative and thus to the enlarger lens. Loss of detail and gradation are not great enough to be objectionable when the degree of enlargement is not more than 5 to

1, therefore enlargers of this type are satisfactory for negatives larger than the $2\frac{1}{4} \times 3\frac{1}{4}$ size.

Other equipment needed for enlarging, in addition to that used in contact printing, includes:

1. An easel of some sort to hold the paper in place under the enlarger lens.



ENLARGING. The author shows, in this illustration, the enlarging set-up, with enlarger and easel. Also shown is a method of dodging, whereby a small piece of cardboard is placed between the negative and the sensitive paper, thus holding back the light of the image in that area
Photo, Gorska-Hill

Having connected the printer to any electric outlet and turned off all lights except the safelight, place the negative on the glass top with the emulsion side up. Adjust masking bands to mask off any part of the negative not wanted, or merely to provide white borders. Then place a sheet of contact paper, selected by grade as already de-

2. The same complement of trays already described, but in sizes large enough to accommodate bigger prints.

3. If it can be afforded, a photometer, or enlarging exposure meter.

The best easel is one with a black, non-reflecting surface. When using an easel with a white surface, always place a sheet of black paper on it, under the enlarging paper, otherwise soft, fuzzy enlargements will be produced as a result of light penetrating the paper and being reflected back through it to the emulsion from the surface of the easel.

ENLARGING PROCEDURE

Place in the easel a sheet of paper (the back of an old print will do) of the same size and thickness that you intend to use. Place the chosen negative in the negative carrier, emulsion side down, and slip this into place above the lens, which should be fully opened.

Make sure that all paper and film in the darkroom is covered, then switch on the enlarger light and move the head up or down until the projected image on the focusing paper is of the desired size. Lock it in place.

Next, focus the image sharply, using the wheel or lever provided for this purpose. If the negative is extremely dense or flat, making focusing difficult, this can be done by substitution. Leaving the enlarger head locked in place, take out the negative and substitute a special focusing negative consisting of lines, circles, and other patterns, which can be bought for very little. When this is accurately focused, remove it and replace the original negative.

Choose paper of the correct contrast as described under contact printing. Or, even better, choose the correct grade with unfailing accuracy by using a photometer, a small instrument which saves hundreds of headaches. By measuring, with this, the densest and the clearest areas of the negative, the exposure range is instantly ascertained and the correct grade of paper for the best possible print is revealed.

The principal difference between enlarging and contact papers is that the former comes in only four grades of contrast, and in three varieties distinguished chiefly for the difference in exposure time required. These

are: bromide, which is very fast; fast chlorobromide; and slow chlorobromide. The best paper for the beginner, and for general work thereafter, is the fast chlorobromide.

Having decided which paper to use, turn off the enlarger light, remove one sheet of paper from the box or envelope, cut this into three or four strips crosswise, and return all the paper except one strip to the safety of box or envelope.

Remove the focusing paper, place the strip of sensitized paper in the middle of the easel and weight it down along the edges with rulers or something of the sort. Then take a large piece of cardboard and cover the strip of paper except for an inch or so at one end. Stop the enlarger lens down about two stops from its largest opening—that is, to about $f/8$ or $f/11$ —and switch on the enlarger light for exactly 4 seconds. Now move the cardboard down another inch or so and turn on the enlarger light for another 4 seconds. Repeat this until the whole strip is exposed and develop it as described under contact printing, except for the element of time.

In setting up for enlarging, the developer should be that specified for the paper being used, and the developing time should be at least $\frac{1}{3}$ more than the minimum specified in the direction sheet which comes with each batch of paper. In other words, if the directions say that the paper requires $1\frac{1}{2}$ minutes to reach full development at 70° , leave it in the developer at least 2 minutes—and $2\frac{1}{2}$ is better.

Then put it through the stop bath and hypo as already described and examine the test strip by bright room light. This will show which is the best exposure time for that particular negative, and the final print can then be made by exposing for the indicated interval.

If this interval is less than 15 seconds it would be wise to stop down the lens still further and make a new test strip, since too short an exposure allows no leeway for errors. When the exposure is 5 seconds, an error of 1 second means 20%. If the indicated exposure is 20 seconds, an error of 1 second would mean only 5%, which would not matter much.

The photometer can also be used to determine exposure time, using it according to directions which come with it. These are none too easily understood at the very beginning, however. Therefore the first few enlargements should be made according to test strips.

DODGING AND PRINTING-IN

Much more control is possible in enlarging than in contact printing. Bald skies can be printed in by "dodging" the foreground. This means withholding from the paper the light that comes through these areas of the negative. This is done by holding a piece of cardboard between the enlarger lens and the paper, and moving it about so that the sky prints in and the foreground does not.

Smaller areas can be dodged, or held back, by using a piece of cotton wool or a cardboard disc on the end of a wire, while small areas can be printed in through a hole in a large piece of cardboard that shuts off the rest of the image from the paper. In either operation, the cardboard or cotton must be kept in gentle motion to avoid sharp outlines about the dodged area.

In all other respects, the technic of enlarging is the same as contact printing.

II. DEVELOPING THE NEGATIVE

The production of brilliant full-toned prints from small negatives calls for the utmost care, precision, and cleanliness in negative developing.

Some of the steps to be outlined here in the writer's technic for producing good small negatives for printing or enlarging may seem needlessly tedious. But this very adherence to a strict and invariable routine is the secret of satisfactory results.

The equipment required for developing 35mm or roll film negatives, in addition to some items used in printing, includes:

1. An adjustable developing tank of Bakelite, or a stainless steel tank with a reel of the proper size
2. Two or more stainless steel film clips
3. A 1-quart graduate or beaker of glass, stainless steel, or enamelware
4. One quart of fine grain developer; any standard brand, preferably that recommended by the makers of the film you use

5. A tank thermometer
6. One small photographic chamois
7. One pound each of potassium chrome alum and sodium bisulphite
8. The same kind of acid fixing solution used for prints can be used for negatives, but the identical solution should never be used for both. Mix a fresh batch for negatives.

PROCESSING PROCEDURE

The instructions which follow are for developing panchromatic emulsions, which are the best all-purpose films for amateur and professional use. Orthochromatic films, such as Verichrome and Plenachrome, used for certain special purposes, are developed in exactly the same way, except that the film may be loaded on the reel of the tank in a darkroom lighted by a deep ruby safelight. The Series OA safelight used for enlarging cannot be used with film.

Having carefully read the directions which come with the tank, practice loading it—first in daylight, later in complete darkness—using a roll of discarded developed film or, better still, wasting one fresh roll for this purpose, to familiarize yourself with the way it is attached to the paper leader.

The writer has found that the best way to work in the dark is to detach the film from the leader completely, allowing the latter to fall to the floor and the film to wind back into a separate roll. All this before starting to load the film onto the reel. With no paper in the way, this is easier.

Having learned by practice to load the tank efficiently, set up the darkroom (and be sure it is dark!) for actual work. Take your place, seated or standing, before a table or bench on which are laid out, in the most convenient arrangement, the reel (adjusted to the right spacing), the tank, the cover of the tank, the roll of film to be developed, and finally, a pair of scissors.

Lock the door so no one can blunder in, turn off all lights, break the seal on the roll of exposed film, wind off and discard the paper leader, including the Scotch tape with which the film is attached. Take the scissors and round off slightly the corners of the film which will lead it into the reel. Now grasp the reel in the manner prescribed in the directions that come with the tank, and gently

BEGINNER'S GUIDE TO DEVELOPING AND PRINTING

force the film through the reel channels. Be sure to handle it only by the edges, to avoid finger marks on the emulsion. When all the film is in the reel and the end behind the lock, place the reel in the tank, find the cover and put it in place securely. Then, and not until then, turn on the lights.

Now, and this can be done before loading the tank, prepare the required amount of developer, acid rinse, stop bath, and hypo solution, and bring all of them to the same temperature—preferably 70° Fahrenheit.

The stop bath consists of $\frac{1}{4}$ ounce each (or roughly, 1 teaspoonful) of sodium bisulphite and potassium chrome alum dissolved in 16 ounces of water. The acid rinse consists of 12 or 15 drops of 28% acetic acid added to 16 ounces of water. The required quantity of each to cover the size film being developed, with some to spare, can be learned

from the tank directions, or by an actual test with plain water, with the correctly adjusted reel in the tank but no film in it.

Ascertain from the developer directions the exact developing time at 70° for the film being used. This is very important, and should be followed to the letter. Measure out the required amount of developer into a lipped beaker or graduate, and pour this quickly and evenly into the tank through the loading mouth of the lid. At the same instant start the interval timer or note the exact time on a clock. If directions call for 15 minutes' development, the time should begin when you start pouring the developer in, and should end as you begin to pour it back into its bottle.

At the beginning of and during development, agitate the tank ten times, by shaking if a metal tank, by twisting the reel if a



SPRING DAY. Outdoor photography is perhaps easiest for the beginner to tackle—and photos of your friends can be interesting for their composition as well as for the faces they show. This shot has excellent compositional value, with good framing of the subject and a pleasing diagonal in the cement wall. Work on composition can be done by masking during enlarging or by cropping afterward
Photo, Harold Harvey

plastic tank. If the developing time is 20 minutes, agitate every 2 minutes; if 15, agitate every 1½ minutes, and so on.

As soon as the developer has been drained back into its bottle, pour in the acid rinse and agitate constantly for a minute or so, then pour this out and down the sink.

Now pour in the stop bath and leave it from 3 to 5 minutes, agitating constantly. Then pour this, too, down the sink. It costs little and won't keep more than a few hours.

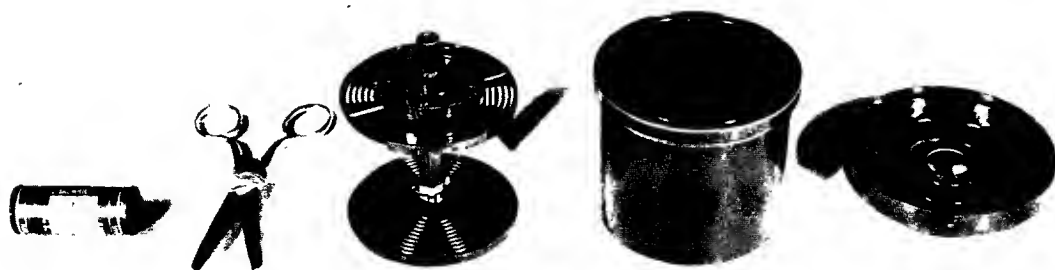
Then pour in the hypo fixing solution, which should be allowed to remain 10 to 15 minutes. Agitate the first couple of minutes,

protected from dust. It will dry in from 1 to 6 hours.

CAUTIONS AND PRECAUTIONS

During all these operations, check the temperature of solutions frequently, using a thermometer that will slip into the closed tank. Keep to 70° by setting the tank in a large tray of water kept at that temperature by heating, or with pieces of ice.

Wash the thermometer under running water after each use, also every graduate, stirring rod, and anything else that comes in contact with the chemicals.



DEVELOPING TANK. At the right are the 3 parts of an adjustable Bakelite developing tank. Such tanks will hold any film from the size shown down to 35mm. In total darkness, the film is stripped from its paper backing, its leader is cut, and it is gently pushed into the reel's grooves. When the reel is inside the cylinder with the cover on, liquid solutions can be poured in and out, but the container is light-tight

Photo, Gorska-Hill

When the hypo is poured back into its bottle, the lid may be removed from the tank and the latter placed under a faucet for washing. About 30 minutes under running water is required for this. The water must be not even one degree warmer than the chemical solutions, and not more than 3 degrees colder at the start. If colder water is used, the washing time will be much longer.

Having been thoroughly washed, the film is removed from its reel, rinsed off again under running water, and a film clip attached securely to one end, from which it is then suspended from a rack, shelf, or something high enough to allow it to hang free. The photographic chamois, thoroughly washed and rinsed, then squeezed (not wrung) as dry as possible, is then folded and wiped gently down the whole length of the film to remove surface moisture. The other clip is attached to the bottom and the film hung up to dry in a warm, airy place, well

Scrub the tank and reel thoroughly after each use and allow it to dry before closing. Never attempt to thread film into a damp reel. It won't go.

After use, wash the chamois thoroughly and put it away in a closed jar of fresh water, which should be changed once a week, or oftener if used frequently.

Filter both developer and hypo through cotton or filter paper after each use.

One quart of hypo should be used for no more than 5 rolls of 35mm or 120 film. It then may be used for prints, after filtering. It is better, however, to throw it away after 5 rolls.

Short cuts and time-saving omissions are fatal to good developing, but carefulness and cleanliness pay big dividends. The beginner who follows to the letter the procedure outlined here will produce as good negatives as the most seasoned professional, which should be the goal of every amateur. For, after all, anything that is worth doing,

is worth doing well. If you are willing to be painstaking you can soon become a thoroughly proficient darkroom technician. If you are not willing to be painstaking you might as well give up photography right now and turn to some other less exacting hobby.

QUESTIONS AND ANSWERS

My job with *The New York Post* includes answering an average of 1,200 question letters a week from amateur and professional photographers, and the scope of their inquiries covers everything from loading the camera to involved problems in photographic optics and chemistry.

Among the questions on processing asked by beginners, the following are perhaps most frequently received:

1. *How can I keep film from sticking and buckling as I push it into the reel of a Bakelite tank?*

Damp film edges (from perspiration on the hands) and moisture in the grooves of the reel are the principal causes of this trouble. If it still sticks, tap the reel lightly on the table, first one flat side, then the other. This will usually start the film sliding again.

2. *What causes a roll of film to come out completely blank and clear after developing?*

Failure to remove the lens cap, failure to pull the slide in a plate camera, failure of the shutter to work, gross underexposure, or use of the hypo fixing bath before the developer in processing.

3. *Can roll film be developed in trays, without a tank?*

Yes, but it is a clumsy, messy job, not worth the trouble. Tank development is the modern and only really satisfactory method.

4. *What is the best developer for films?*

Usually the one recommended by the manufacturer of the film, although any standard brand will do if instructions are



INSIDE A DARKROOM. Familiar to many photographers is this typical darkroom scene—showing a negative being inspected after it has been in the hypo fixing bath. Here are the 3 trays used in developing, the wall-attached safelight, the darkroom clock. This darkroom is also equipped with a sink rack and faucet tube for washing
Photo, Mechanics Institute, Rochester

followed. Generally speaking, a fine grain developer should be used for all negatives less than 4 x 5 inches, and the smaller the negative the more necessary this becomes.

5. *What is the purpose of the acid rinse used between the developing solution and the stop bath?*

The softened gelatin becomes impregnated with the strong alkali of the developer and if plunged directly into the highly acid stop bath, tiny explosions will occur in the gelatin as the acid and alkali meet beneath the surface and form gas. These explosions leave little holes in the emulsion, which show up as solid black when printed or enlarged.

6. *Is developing by inspection of any advantage to the beginner?*

None whatever. The time-temperature method is much more reliable than the judgment of a beginner's untrained eyes. As a matter of fact, most of the skilled professionals have abandoned inspection development for the scientific surety of tank developing.

7. *Must photographic solutions be kept in dark bottles?*

Not necessarily, but amber photographic bottles are usually safer than ordinary clear glass, which frequently contains free alkali in sufficient concentration to contaminate

delicately balanced developers. Hypo can be kept in any non-metallic container.

8. *Should film be soaked in water before developing?*

No. This former practice is neither necessary nor desirable with today's films.

9. *How can reticulation be corrected?*

It can't, but it can be prevented by careful regulation of temperature during developing.

10. *What causes spots on prints?*

Black spots are caused by pinholes in the negative, due to dust in the camera or explosions as described above. Also by dust on the printing frame or between the negative and paper.

White spots are caused by drops of water, stop bath or hypo splashing on the paper before development; also by air bells formed on the surface of the paper when it first enters the developer, unless wiped off at once.

Spots of various colors are caused by chemical dust settling on the paper. For this reason, the darkroom should be kept scrupulously clean.

11. *What causes enlargements to appear blurred and indistinct?*

Incorrect focusing, or movement of the enlarger during exposure. A shaky enlarger or a weak table or stand is a hazard hard to overcome.

12. *Should bromide be added to the paper developer, and if so, what effect will it have?*

The addition of a small quantity of potassium bromide to a metol-hydroquinone developer will usually increase the contrast of a print somewhat. This is not an experiment recommended for beginners, however. Changing to a paper one grade harder is preferable, where greater contrast is demanded.

BELL & HOWELL COMPANY

The development of a large photographic manufacturing company is discussed in this summary of Bell & Howell's history. Professional and amateur motion picture cameras, projectors, splicers, and other accessories are described.

See Also Cine Photography

might be designed and constructed, it would be impossible to obtain faultless projection, free from flicker and unsteadiness—unless all types of machinery used in the new industry were designed and manufactured in strict and close relationship to each other. Each apparatus must be a link in the chain of complex cinematographic processes.

PROFESSIONAL EQUIPMENT

Attention was first directed, therefore, toward the standardization of film perforations. The first Bell & Howell perforator made its appearance in 1911. Today, Bell & Howell perforators do approximately 90 per cent of both negative and positive film perforating throughout the world.

Next came the question of creating machinery which would make possible high film production volume. The result was the invention of the Bell & Howell continuous printer which displaced the then existing step printer. The perfection of this engineering feat increased production from between 17 and 20 feet of film per minute to 60 feet per minute and over.

The Bell & Howell Company next devoted its attention to the motion picture camera. Steadiness of the picture on the screen is dependent upon the exact registration of each picture frame in the camera. In the Bell & Howell professional camera is the film-moving mechanism known as the Unit "I" or shuttle movement. This radical departure stabilized film in its photographing position by two stationary pilot or registering pins. Any variations, even if exceedingly small, which are in the perforations due either to accumulation or manufacturing tolerances, or to film shrinkage, are thus accommodated. The camera insures not only steadiness in projection but also the ability to perform the most intricate multiple-exposure work. The Bell & Howell camera was the first all-metal camera, too. All its parts are enclosed in a die-cast aluminum casing and this original conception marked a complete change from the then customary wooden camera.

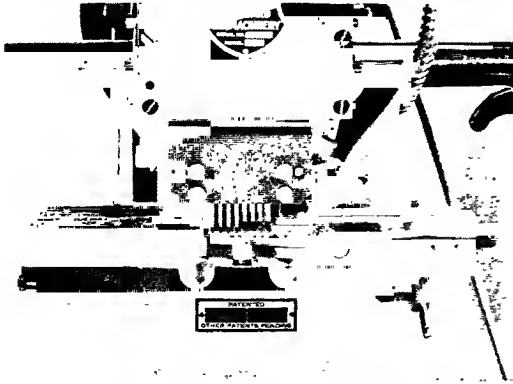
The next step in the Bell & Howell Company was taken in 1915, with the introduction of the first professional film splicing machine. Film splicing may appear a matter of little importance, but for the public per-

THE FOUNDERS of the Bell & Howell Company in 1907 realized that regardless of how accurately a motion picture projector

BELL & HOWELL COMPANY

fect splicing means uninterrupted showings in the theater; for the laboratory, it means the smooth running of film and a safeguard against damage.

The efficiency of each major machine is increased by the availability of numerous attachments and accessories devised to solve



BELL & HOWELL FILM PERFORATING MACHINE

problems of the motion picture industry. The first motion picture mechanical research and engineering laboratories were established by Bell & Howell in 1929.

A list of some Bell & Howell standard 35mm equipment and 16mm laboratory equipment is given below. Other equipment is being added to the list constantly, as the research laboratories are always at work.

STANDARD 35MM EQUIPMENT

- Film Perforating Machine
- Studio Camera
- Hand Portable 35mm EYWMO Camera
- Photo and Projection Lenses
- Continuous Contact Printer
- Non-Slip Sound Printer
- Developing Machines
- Developing Control Instruments
- Film Splicing Machine
- Film Measuring Machine

16MM LABORATORY EQUIPMENT

- Picture, Optical Reduction Printer
- Sound, Optical Reduction Printer
- Contact, Continuous Printer
- Film Developing Machines
- Developing Control Instruments
- Film Splicing Machine
- Film Measuring Machine

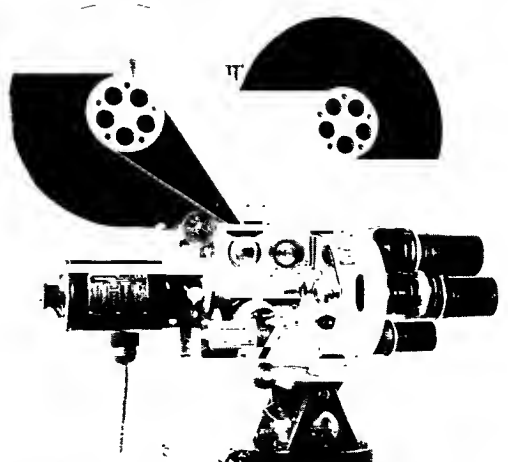
AMATEUR EQUIPMENT

Another step came when the Bell & Howell Company turned its resources to the development of machinery for the home movie maker. Not only were cameras and projectors designed and built for amateur use, but laboratory equipment was produced which has contributed much to the acceptance of 16mm film within the educational and industrial fields.

The silent cameras and projectors, both 8mm and 16mm, are known as Filmo equipment. The sound-on-film projectors are known as Filmosounds. Here is a list of available equipment:

8MM AMATEUR CAMERAS

Filmo Companion Eight	Least expensive of amateur cameras; 24 oz.; four speeds; f/3.4 Universal focus lens; built-in view finder; single frame exposure button; rotary disc shutter; 25 feet of double-run film
Filmo Sportster Eight	f 2.5 lens, fixed focus, slow-motion speeds
Filmo Aristocrat	Three-lens turret with 1-inch, 1½-inch, and 2-inch lenses; positive view finder with objec-



BELL & HOWELL STANDARD PROFESSIONAL CAMERA. Notice the electric motor at the left, the large film capacity, the multi-lens turret, the footage indicator, the pivot-head tripod and panoraming arrangement

THE COMPLETE PHOTOGRAPHER

tives matching lenses; single exposure device; critical focuser

8MM PROJECTOR

Filmo Master Gear driven; power rewind; 500-watt illumination; direct beam optical system; still picture projection; cooling system; rotary disc shutter; AC or DC; 200 feet

16MM AMATEUR CAMERAS

Filmo Auto Load Pre-threaded magazines; single lens; positive view finder

Filmo Auto Master Turret camera; 3 lenses with matching view finder; magazine loading

Filmo 70-DA Three-lens turret; 7 operative speeds; variable spy glass view finder; critical focuser; 100 feet; built-in lens shades

16MM SILENT PROJECTORS

Filmo Diplomat 400-feet; 2-inch, f/1.6 lens; motor and gear drive; cooling system; single frame projection; sound-track also

Filmo Master Same as Diplomat, but no variable resistance or voltmeter

Filmo Showmaster Same as Diplomat, but 2000 feet

Filmo Auditorium Same as Showmaster, but larger; humidifier; tension take-up

16MM SOUND PROJECTORS

Filmosound Commercial 2000 feet; motor and gear drive; governor speed control; 24 fps; cooling system; tension take-ups; mike input system; push-pull amplifier; tone and volume control; f/2 lens

Filmosound Academy Same as Commercial, but 2-case model; 16 and 24 fps.

Filmosound Utility Same as Academy, but f/1.6 lens; clutch for still pictures

Filmosound Master Same as Utility, but amplifier has 3 audio stages

Filmoarc Carbon arc projector for sound

BELLOWS. The accordion-like folding portion of the camera which connects the lens mount with the back, permitting focusing. The bellows is usually made of leather or black cloth. It collapses when the camera is folded shut. In modern miniature cameras a helical-threaded metal tube is used in place of a bellows.

Bellows often become split, letting light leak into the film. The following mixture can be used in repairing such breaks:

Sperm oil....	3 oz.	85cc
Acetic acid...	3 dr.	11cc
Glycerin.....	3 dr.	11cc
Oil of turpentine...	$\frac{1}{2}$ oz.	14cc
Water to make...	15 oz.	425cc

Small tears in the bellows can be repaired with black sticking plaster. A stiff bellows can be softened by rubbing it with a rag moistened with castor oil or sweet oil. It will be necessary to repeat the treatment daily until the leather becomes soft and pliant.

BETWEEN-THE-LENS SHUTTER. A diaphragm shutter, such as the Supermatic, which is located between the front and the back elements of the lens. The shutter is composed of a body through whose center there is a circular opening equal in size to the diameter of the lens. When the two component parts of the lens are screwed in front and in back of this shutter, the shutter body takes the place of the ordinary tubular lens mount. The space between the lens parts also contains the shutter blades, which are thin leaves of metal overlapping to close the central opening. These pivot back into the outer casting in such a way that when the shutter is operated it opens from and closes to the center of the lens.

The simplest type of between-the-lens shutter has only two blades and requires no cocking. A limited range of speeds is available on these shutters, depending usually on the variations in the tension of the driving spring. This spring, which drives the shutter, is compressed as the release lever is depressed. The shutter, therefore, begins to close the instant the blades are fully open.

The more complex shutters have a double action, two distinct movements for opening and closing. For low speeds a clockwork brake is brought into action to delay the closing, but in high speeds there is no interval between the completion of the opening and the beginning of the closing. These shutters may be set from 1 second to $\frac{1}{3000}$ second. The efficiency with which they operate varies from 100 per cent at the slowest speed, to 50 per cent at the fastest. A powerful spring, which must be tensioned before each exposure, provides the power for operating this mechanism.

The between-the-lens shutter is the most common type of front shutter, although the before-the-lens is used sometimes on box cameras and the behind-the-lens on portrait cameras. As opposed to this between-the-lens or diaphragm shutter (so called because of its proximity to the diaphragm), there is the focal plane shutter. This operates directly in front of the film itself and has a rolling curtain which admits light through a permanent or variable moving slit. Some cameras, the Speed Graphic for instance, are equipped with both between-the-lens and focal plane shutters, having the advantages of both.

BIPACK. Two films placed together in a single holder and used with a third film, also in a single holder, to produce three color-separated negatives. The two films of the bipack are exposed one through the other. When used in a one-shot color camera, the bipack receives the direct image, the third separation negative is exposed by reflection.

Bipacks are used in two-color work. In this, the front film is orthochromatic, blue-green sensitive, with an orange-red gelatin filter. The rear film is panchromatic and is yellow-red sensitive. Many bipack films are available commercially—the Du Pont 121 and 119, for instance.

BIG BERTHA CAMERAS

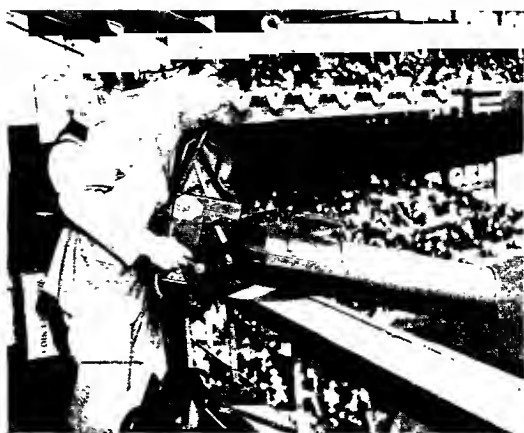
William C. Eckenberg, A.R.P.S.

Staff photographer, New York Times, Rotogravure Section

Big Bertha cameras have lenses ranging from 28 to 60 inches in length. Hard to handle, these cameras often produce remarkable shots, particularly of sports. The author, long a newspaper photographer, has used Big Berthas often and tells about this interesting photographic machine.

See Also Telephotography

THE LONG range camera, more familiarly known as Big Bertha, is an indispensable piece of equipment in practically every newspaper office. Almost every organization is using some type of telephoto equipment. The popular outfit however is the 28-inch



AT A WORLD SERIES. Hugh Broderick of International News Photos is shown operating his 40-inch Big Bertha at a recent World Series. With baseball, a photographer can find his distance to any of the four bases beforehand and then focus in a split second
International News Photo

Zeiss Triplet. There are also a number of 40-inch Dallmeyer f/8 telephoto lens cameras in use. More recently the 60-inch Dallmeyer f/8 has been introduced. While this camera is too long for baseball it has proved valuable for certain types of assignments. It is huge and requires at least two people to carry it. Not so long ago a lens working at f/8 was considered too slow for action photography. The advent of the new fast film has overcome this, however.

All of these cameras are bulky and quite heavy. This is understandable when we consider that they must be rigid in order to

stay in alignment. Then too they are subjected to hard usage in all kinds of weather and under very severe conditions, so they must be sturdy. Both the 4 x 5 and 5 x 7 Graflex cameras are used for the long lenses but in most cases the 5 x 7 is preferred. The operation of the camera is about the same except that the focusing is much more critical than with the short lenses. This of course is due to the shallower depth of field in the long focal length lenses.

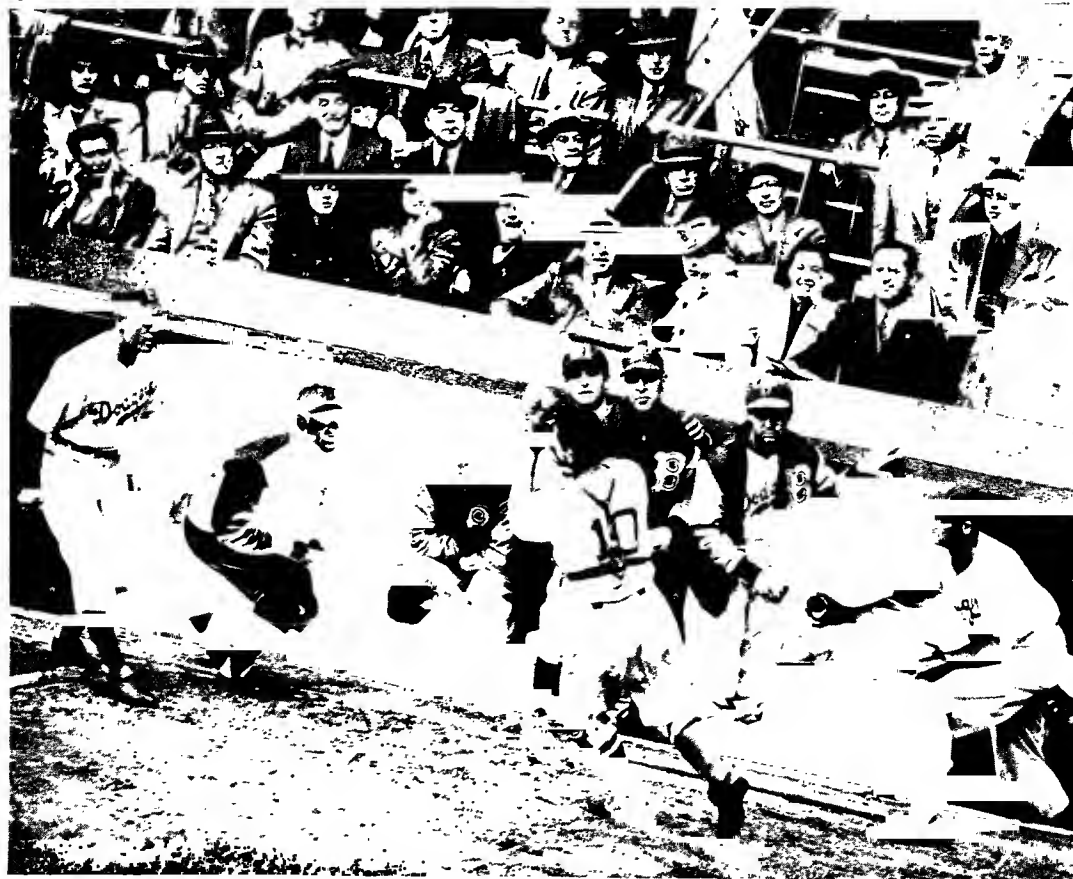
When window jumping was popular in New York, it was the Bertha which was used to make pictures from adjoining buildings. It has also been used to make advertising illustrations and other types of pictures.

SPORTS

The increased demand for pictures of sports events such as baseball, football,

tennis, horse racing, and prize fights brought about the need for good long range cameras. At one time it was possible to work on the field when making baseball and football pictures. As a matter of fact there are still some fields where sideline photography is permitted. In most instances officials felt that the cameramen were in the way. In order to avoid possible interference with the game and annoyance to spectators, they were ordered off the field at most of the major league ball parks and many of the football stadiums.

It has not been too much of a handicap for the photographers to work at a distance. Covering baseball from the stand affords a greater opportunity to watch every part of the field. Pictures can be made of any portion of the field by merely swinging the camera.



POP FOUL. Something new in baseball pictures is this one of Mickey Owen of the Dodgers catching a pop foul. A quick-thinking photographer behind a Big Bertha camera got this interesting photograph, an action shot and a study in expression. Notice the Dodger manager's wife, extreme left, her hands and face making a picture of mental anguish

International News Photo

BIG BERTHA CAMERAS

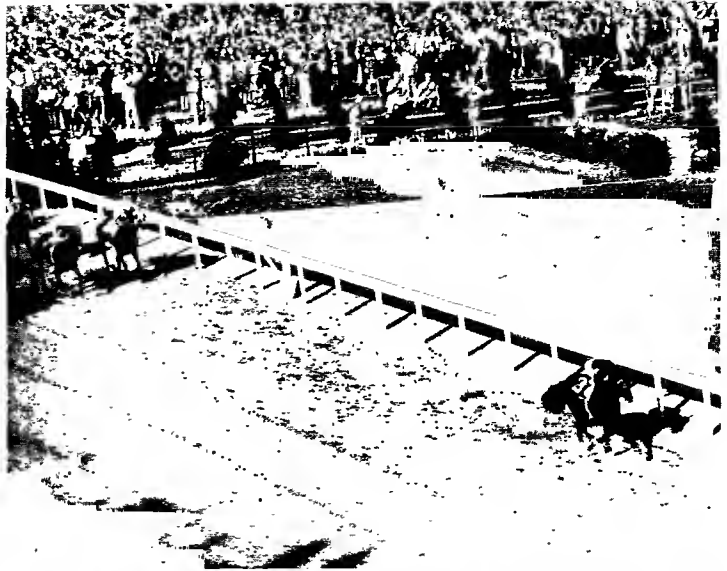
The same applies to football, where photographers work from the top of stadium stands. Many important pictures made at football games with these super cameras, would have been out of range of cameras on the sidelines. Football pictures made on the field can be far more dramatic, but it is easily understandable that a photographer cannot give the game as complete coverage from the ground as from the stand. Many football coaches took immediate advantage of the Bertha pictures. They used them to show players instances of faulty blocking and defense.

Great tennis pictures have been made with the big cameras. Before provisions were made for Bertha cameras, photographers had to be content with a few average practice shots before play started. They were then forced to leave the field to make general views from the stand.

Smashing pictures have been made with the long cameras at the race track showing horses rounding a turn. They can always be found in action at the Kentucky Derby. Cameramen operate them on the roof just below the finish line. Too often it has been found that a race is spread out with a long gap between the winner and the other horses. When this occurs the photographer on the track gets a picture of a one horse finish. This was the case at one Derby and most of the pictures published were those made from the roof.

AT THE OPERA HOUSE

Last season the big camera invaded the confines of the Metropolitan Opera House. The Editor told me he would like if possible to see action pictures rather than the posed type which had always been made. It was therefore my privilege to experiment with the camera at the famous house of music. My tests proved so successful that arrange-



WHIRLAWAY WINS THE DERBY. In horse racing, a Big Bertha camera is a virtual necessity since the action covers such a large area. Here is Whirlaway winning the Kentucky Derby—a remarkable shot, with the horse all alone out in front, shown in sharp detail against a background of screaming crowds. Notice the dust which the winner has kicked up

Photo, Wide World

ments were made to shoot all the important operas. Up to that time no actual performance pictures had ever been attempted. Mr. William Freese, Manager of *The New York Times* Studio, arranged for the set-up and together we covered twenty-five operas.

It is common knowledge that the real opera lover considers silence a sacred privilege during a performance. The noise of a rustling program or a pin which has been dropped, will guarantee immediate reactions from an opera audience. It was therefore necessary to soundproof the equipment so that no one would be disturbed by the noise of the camera. I found that most of the noise was made when adjusting the mirror and shutter after making a picture. By holding the shutter release down when adjusting the mirror I eliminated the click. When rewinding the shutter I held the curtain release on the right side of the camera while winding the curtain, thereby avoiding any undue noise.

Advance planning was both necessary and helpful. Before shooting a performance I made it a practice to study the libretto in order to thoroughly understand the plot. In that way I was able to get a good continuity

set of pictures and could also watch for important spots in the opera. While I was setting the camera on a short coupled motion picture tripod on which the swivel was kept loose to permit swinging the camera, Mr. Freese contacted the technical staff and performers backstage. From the electricians he obtained valuable information about the lighting for various scenes. Lighting was perhaps one of the most difficult problems. A scene might start quite bright and in a matter of a few minutes it would melt into a subdued light. Not only would the intensity be changed but the color varied from white to orange or to blue. I found it necessary to keep my eyes fixed on the ground-glass almost constantly in order to note the changes in the light. The stars themselves were most anxious to help us if they could. If Mr. Freese told them we wanted to get a

certain scene and the light was of poor grade they would volunteer to hold a pose at a particular time in order to insure a good picture. At times the exposures were as slow as one second in poor light. The fastest I was able to operate was $\frac{1}{25}$ second.

Stage directors also proved equally helpful. One of them in particular was keenly interested in the venture. He is an ardent camera enthusiast in addition to being a fine director. Many times he would stand beside me offering valuable advice on forthcoming action. On one occasion he ordered stronger light in a moonlight scene so that I could get a picture.

THE CAMERA—RECENT DEVELOPMENTS

Structural improvements are constantly being made in order to lighten the camera. Most of the modern Berthas have a strong



DON PASQUALE. Opera scenes, such as this garden setting, are often dimly lit and present quite an exposure problem. With the Big Bertha and ultra fast pan, however, action shots are possible. DATA: 28-inch Big Bertha, extra fast pan film, $\frac{1}{25}$ second, $f/5$
Photo, William Eckenberg, New York Times

BIG BERTHA CAMERAS

bed, the frame of which is usually made of channel duralumin. A metal cone extends from the leather bellows of the Graflex to the lens. This mechanism runs on a track which is attached to the bed. The camera is still too heavy and too long to be hand held and must be supported by a tripod or rested on a rail when in use.

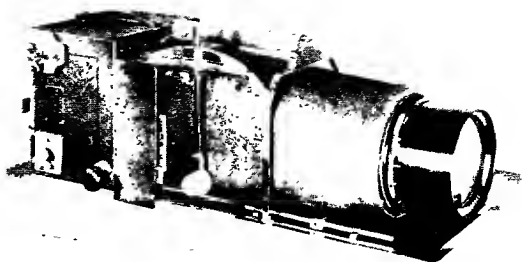
One of the recent developments has been the gear shift focusing device. This has been especially fine for baseball assignments. It enables the photographer to do his focusing in advance on the various bases. Then by



THE BARTERED BRIDE. An action shot at the Metropolitan Opera House in New York, this is the first of its kind. As opposed to the usual posed opera photograph, this shows action and captures much of the carnival spirit of the opera. For pictures such as this, the photographer must know his opera libretto and work fast when the picture possibilities arrive. **DATA:** 28-inch Big Bertha, extra fast pan film, $\frac{1}{25}$ second, f/5 Photo, William Eckenberg, *New York Times*

merely shifting the lever to a stop which has been locked in place while pre-focusing, his picture is sharp. This does away with the need for groundglass focusing when split-second action takes place. Most always a photographer anticipates action at a certain place on the field but the unexpected often happens. He must then hurriedly shift the camera and refocus unless he is using the gear shift. Many fine pictures have been lost because of the need for focusing.

James Frezzolini, an electrician at the *New York Daily Mirror* has built several of the latest Berthas. He told me that one of their old 48-inch cameras originally weighed 120 pounds. After reconstruction, using dural metal throughout, the camera now weighs 65 pounds. On his camera a cone runs di-



A NEW BIG BERTHA. One of the more recent and streamlined of the Big Berthas, this camera is a combination of a Graflex and a 28-inch lens. Notice the lever for quick focusing, the lens which has aperture openings from f/5 to f/32

rectly from the Graflex box. The lens is attached to a sleeve which operates inside the cone and moves on ball bearing rollers. The focusing mechanism is worm drive. This makes it impossible for the camera to run out of focus by sheer weight of the lens when it is tilted. Another feature is his patented diaphragm control. This is a conveniently located knob and dial showing the various f-markings. It eliminates the need for reaching out to the end of the camera to change the diaphragm opening because of fluctuating light.

Each year pictures made with Bertha cameras win salon prizes. A dramatic baseball picture made by Ernest Sisto of Times Wide World Photos has won first prize in the sports section at the Press Photog-



LAUNCHING THE U. S. S. NORTH CAROLINA. It is always an exciting moment when champagne is cracked on a ship's bow—but the photographer is not always allowed within range. A Big Bertha camera made this shot possible—at exactly the right moment
International News Photo

raphers' Association of New York exhibit. Also a picture made by Michael Ackerman of Acme News Pictures showing the launching of a battleship won a prize. Made with the 40-inch lens the picture had real punch because of the marvelous perspective and roundness. Other pictures of the launching made at closer range with the short lenses were good but they were not as dramatic.

So, while it is often a backbreaking job to lug the heavy Berthas to the top of stadiums and many other lofty perches, I think all news photographers will agree that they receive worthwhile dividends in great pictures for their effort.

BIOLOGICAL PHOTOGRAPHY

Oscar W. Richards

Research Biologist, Spenser Lens Company, Buffalo, N. Y.; Director, Biological Photographic Association

Biological photography means many things—it means work in the field, in the laboratory, work with plant and animal behavior and many other aspects of the science. Photography can be useful to the embryologist, the morphologist, the physiologist, the paleontologist, and others. Dr. Richards here tells of the special photographic problems of each branch of biology—and of the equipment and procedure to use. The author, once a professor of biology, also has a very interesting section on the uses of photography in biology teaching.

See Also Animal Photography, Botanical Photography, Medical Photography, Science and Scientific Photography, Teaching Films

PHOTOGRAPHS are used abundantly in biological science and few subjects are as fascinating to photograph as living organisms. Many of the pictures are made for record purposes and must adequately document the subject. Others show the beauty of form created by living plants and animals. An artistic photograph with correct detail is preferred, but clarity and accuracy may not be sacrificed. Soft focus and similar methods are little used in scientific photography.

The outstanding biological picture arrests the attention, demands examination, and satisfies curiosity. To make such pictures the photographer must first decide how and what the picture is to show. Planning may be more important in scientific than in other branches of photography, because the picture must be accurate according to scientific

truth. This does not mean that an accidental find of the makings of a good biological photograph should not be used; rather it asks that before exposing one should be careful to take it so that it will be an asset after it is developed.

Both plants and animals are living organisms. Sometimes they must be photographed together, other times separately. Successful biological photography requires knowledge of the characteristics and habits of the organisms to be photographed as well as sufficient ability and equipment to make the photograph. Photographers unfamiliar with biological subjects can only hope for chance success without help; likewise biologists without training in photography rarely find luck with picture taking.

The broad field of biology will be summarized systematically to show how photographs are used and the kinds required. Some of the special problems will then be examined. A familiarity with the usual materials and procedures of photography is assumed.

FIELD STUDIES AND ENVIRONMENTS

Ecology is the branch of biology concerned with the relations between living organisms and their surroundings. The damage done to the fruit tree in the yard may be photographed or one may go halfway around the world for exotic plants and animals. Great care should be paid to details in these photographs as they may be used later for photomurals or as guides for the reconstruction of the region in miniature in a diorama or museum exhibit.

Field studies require careful planning especially when long trips are to be made. Equipment will be discussed later. The assistance of someone familiar with the habits of unusual organisms may be essential. It may not be amiss to warn the field photographer against poison ivy or oak, and militant insects.

Everyone knows that certain plants and animals can be found only in certain places. The biologist divides the world into life zones. Knowing the life zones one can estimate roughly the elevation and the kinds of organisms likely to be found as the view passes by the car window. The photographic

BIOLOGICAL PHOTOGRAPHY

problems vary from high mountains to hot deserts. It may be necessary to show the nature of a broad region or a single plant or animal against the normal background of its life.

Changes in terrain are revealed by aerial-photos and such photos are very useful in locating regions photographed. It is exceedingly important that the field records show exactly where each photograph was taken as well as what it shows. Aerial surveys or topographic maps should be used and one of the standard record forms for field work should be kept as well as records of exposure and other photographic detail.

FILTERS

In the high mountains there is little dust to decrease the light, and distant objects appear nearer than in lower regions with dense atmosphere to absorb the light. It is unwise to guess exposures under conditions not familiar to the photographer. A good exposure meter should be used and its peculiarities with regard to spectral sensitivity, temperature effects, etc. must be known and allowed for when using it. Distant objects are photographed through a light yellow or green filter to penetrate haze. Infrared sensitive negative material is useful when the different balance is needed. It may be used to show the proportion of conifers to deciduous trees or other color contrast within its resolution. The type of filter used will depend on the sensitivity of the plate or film, and the contrast desired in the negative. But filters must not exaggerate the colors, tones, or contrasts.



POISONOUS MUSHROOM. When photographing in the field, it is good to show the general aspects of the surroundings without having the background interfere with the clarity. Familiar leaves in the background here indicate the size of the mushroom

Photo, Oscar W. Richards

TELEPHOTO PHOTOGRAPHS

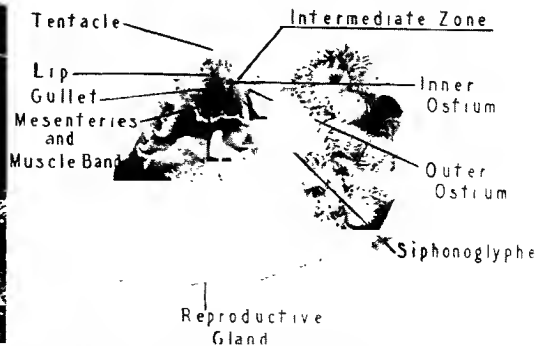
Telephoto lenses are useful and often essential, not only to show such scenes as a mountain goat on a high ledge, but also to give more natural pictures of small animals or plants when the photographer cannot approach the organism closely. Bird pictures and spiders in their webs may be photographed to advantage with telephoto lenses.

The picture may be taken through a telescope or one side of a binocular field glass when a telephoto lens is not available. Focus with a normal eye or with spectacles (when they are required for distance vision) and set the camera lens to infinity. The camera should be held firmly against the telescope to avoid vibration and so that the optical axis of the camera is in line with that of the



SEA ANEMONES. In a tide pool these animals were found and photographed. Often biological species such as these are found in inaccessible places

Photo, Oscar W. Richards



SEA ANEMONE—CUT AWAY. Brought into the laboratory these sea animals were cut away to show structure

Photo, Silas Nourse

binocular. The picture will then be in focus on the film. Field glasses are convenient because one side may be used to center on the subject, when the camera is small enough to go on the other eyepiece. The exposure will depend on the distance to the subject and the magnification. It is well to take a test exposure at several distances to find out the proper exposure factors. Any lack of perfection in the telescope will degrade the photographic image; thus one cannot expect good results from toy telescopes or glasses.

SPECIAL FIELD PROBLEMS

Plants may be in full flower only at certain times of day and many of them orient their leaves to the sun so that the best picture can be obtained at only one time. Perfect specimens should be photographed. When this is not possible the picture should be taken so as not to call undue attention to defects or injuries. In field work it is usually necessary to take the plants where they grow. Proper planning and lighting then make the difference between an excellent photograph and another snapshot. Interfering material should be removed from around the subject if possible.

A mirror may reflect to the camera lens a bird nest, the burrow of an animal, or an inaccessible spot which couldn't be photographed otherwise. For perfect results a front-surfaced mirror is necessary. Careful shading of the mirror and the use of a polarizing screen can minimize the double reflection from an ordinary back-surfaced mirror. Another mirror, or more, may reflect light onto the subject. Flashing a bright light on an animal may freeze its action long enough to make an exposure, although another kind of animal may run away instead.

Nocturnal animals can be photographed easily with photoflash bulbs and a properly synchronized outfit. Animals may be baited to bring them to the camera, or a trip line placed over their runways so that they will take their own pictures.

Many animals hibernate in a sleepy state during the cold of winter. Others estivate similarly to tide them over the heat of summer or during the dry season. Photographing these stages requires a series of pictures showing the region, how the animal is hid-

den, the process of digging it out, and how it appeared when exposed.

CAVE PHOTOGRAPHY

In cave photography a sturdy tripod that may be easily adjusted even when the legs are under water, is an important aid to good pictures. Caves are cool and moisture may condense on both the front and the back surfaces of the lens unless the camera has been allowed to cool slowly. A piece of waterproof canvas or oil cloth is useful to protect the camera from falling water and animal excreta. When it is necessary to swim from place to place, a floating waterproof container should be provided to carry the photographic material. Practice is necessary until the photographer can make the ordinary adjustments in darkness or with very little light. Exposures are best made with photoflash bulbs. Flash powder is undesirable as it will fill an unventilated cave with fine ash which may prevent or delay further photographs. With adequate ventilation flares may be used for motion pictures or photoflood bulbs may be run for brief periods from radio "B" batteries or from a portable generator.

Some caves contain explosive gases and it is wise to test the air of an unknown cave before entering. True cave animals are usually blind or have poorly sensitive eyes. Cave organisms often blend well with their surroundings so that the photographer will have to gain contrast by careful lighting.

UNDERWATER PHOTOGRAPHY

Underwater photographs can be taken only rarely without additional equipment. Unless the camera can be trained onto the object nearly perpendicular to the surface, the reflection of the water surface will lessen contrast, or may even completely block penetration. If the surface is not smooth it is usually not possible to make pictures. Much of the glare of a flat water surface can be avoided by using a Polaroid filter. The filter is turned to show the best detail when using a reflex camera. With a single-lens camera the best position is found by eye and the filter placed in the same position on the camera. The eye should view the scene from the position of the lens.

A hydroscope, made by replacing the bottom of a bucket with a piece of plate glass, may be used to penetrate the water surface. For use under water the camera must be mounted in a waterproof housing with electrical or mechanical controls brought to the outside through waterproof bushings. Sea water is very corrosive and the housing must be made of resistant material. Should a camera be dropped accidentally into the ocean it must be cleaned with fresh water and wiped dry within a very few minutes. Delicate metal parts may rust out within an hour.

PHOTOGRAPHY OF PLANT AND ANIMAL BEHAVIOR

Plants do not show much movement, but do orient themselves to light and to gravity. Some of the smaller plants can move and usually have to be photographed under the microscope in the laboratory. Tropisms or forced orientations can be shown with the direction of the light or other directing force. A light beam may be made visible by blowing smoke or scattering dust into it. Successive pictures, on the same film, may be used to show the changes in position, such as the limited motion of partial paralysis, or to measure the effect of growth hormones. Each exposure should be the least that will give an image and too many should not be taken on the same plate. The background must be dark so that there will be unexposed silver available for the remaining exposures.

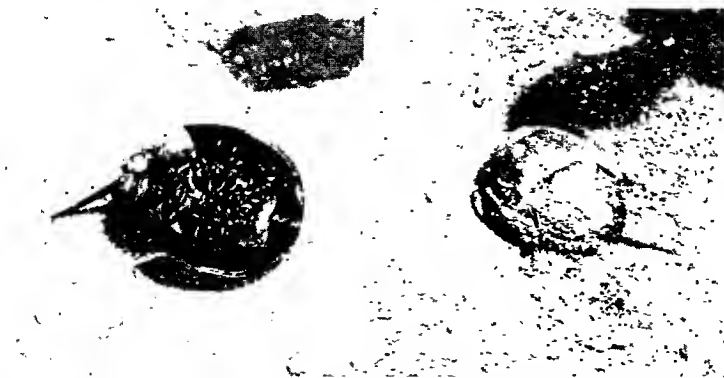


LOCUST. Specimens can often be photographed if a mild anesthetic is given. Care must be taken to avoid hurting such specimens as locusts with strong floodlights
Photo, Silas Nourse

The lower animals also respond in definite ways to directed stimuli, and may be photographed in much the same way. Good photographic records are important for behavior studies. Since animals move rapidly, the motion picture camera gives the best record. Slow motion is helpful when the sequence

of rapid movements is to be analyzed. Care should be taken to provide a suitable and unobtrusive background. Sometimes a small light may be fastened to the part to be studied and the path of the movement can then be photographed in a darkened room.

The social behavior of groups of animals provides useful and interesting photographs. Feeding reactions, mass movements and migrations, defense reactions, and mating behavior all fall in this broad classifi-



HORSESHOE CRAB. This is an underwater shot—taken from above the water's surface. Filters are often necessary to penetrate the water and great care must be exercised to avoid reflections. The photo at left shows the Horseshoe or King Crab on its back, giving details of the shell and leg structure; the photo at right pictures sand scooped on its back as camouflage
Photo, Oscar W. Richards



RAT EMBRYO. Showing the different effects of different lighting arrangements—this same subject was first lit (left) with surface illumination against a black background. Then it was lit with transillumination. The surface lighting brings out flesh texture and shapes, while the other shows internal structure

Photos, J. S. Nicholas

cation. Usually such pictures must be made in the field; sometimes they can be staged in the laboratory.

Certain animals can change their coloring when placed on different backgrounds (fish, amphibians, and reptiles). Others are naturally formed to be very difficult to see, e.g. the insects shaped like leaves or sticks. Some crabs cut off bits of sponge to cover and protect themselves from their enemies. All of these forms make fascinating as well as useful pictures. While man himself has practiced camouflage skillfully, he can still learn from the animals and plants.

For thousands of years many animals have used inventions that man has discovered only recently. The tube feet of the starfish work hydraulically and did so long before man appeared on the earth and invented the hydraulic elevator. Other forms have likewise anticipated man. Photographic studies may lead to other useful inventions. How does the millipede move so as not to get his legs tangled? We do not yet know how some microscopic plants like *Oscillatoria* accomplish their fairly active motion. Motion pictures provide interesting analyses.

EMBRYOLOGY AND DEVELOPMENT

The changes as the fertilized egg cell gradually transforms itself into the adult were

never fully appreciated until tachygraphic motion pictures, taken at suitable intervals, gave a speeded up comprehensive view of the process. This is the exact opposite of the slow motion type of film. Plant growth and development has been shown from the sprouting of the seed, through flowering and fruit formation. Since the film shows only the external changes in direct photography, some films have animated drawings added to show the internal changes as well. The equipment may be quite simple for some work; for others it is highly elaborate and complex. The egg may be observed only once but the

film may be repeated until the process is understood.

When the motion picture equipment is not available a series of still pictures may

(Continued on page 433)



DEVELOPING RAT—CROSS SECTION. This photomicrograph shows in great detail the internal architecture of the eye and ear of a developing rat

Photo, J. S. Nicholas

COLOR SECTION



SWIM TIME

LATZLO WILLINGER

Here is a good example of 5 x 7 Kodachrome Daylight Type Professional Film. For complete information see special articles on *Kodachrome Photography*



PLAYTIME

From a Kodachrome original

Quick actions of children and animals in full color are easily caught with the use of Kodachrome Type A or Type B for artificial light. See *Babies, How to Photograph Them* and *Child Photography*.

COLOR SECTION



NEW PETS

From a Kodachrome original

This reproduction from a 35mm Daylight Kodachrome Film shows the outdoor use of this film for getting unposed natural looking action pictures



FINAL INSPECTION

RUDOLF H. HOFFMANN

Here is an excellent example of the practical use of multiple flash for indoor color pictures. Two G. E. No. 21 Flashbulbs were used with a setting of $f/11$ and $\frac{1}{50}$ second exposure on 5 x 7 Professional Type B Kodachrome



CIRCUS DAYS

From a Kodachrome original

Many colorful subjects are to be found each year when the circus comes to town. Outdoor and indoor color film can be used successfully. See story on *Circus Photography*

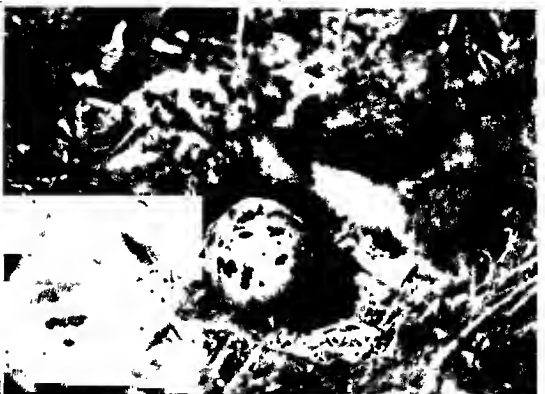


YOUNG GREAT BLUE HERON

ALBERT W. SIMMONS

The above photograph as well as the 6 color reproductions on the opposite page were all made from 35mm Kodachrome originals by Albert W. Simmons. Read his fascinating story on *Bird Photography*. DATA: 135mm Elmar, $\frac{1}{500}$ second, $f/6.3$

COLOR SECTION



Portrait of a Drake Wood Duck. DATA: 50mm Elmar, $\frac{1}{50}$ second, $f/6.3$, 12mm extension tube on Leica camera, 35mm Kodachrome

Portrait of a Copper's Hawk (juvenile). DATA: 50mm Elmar, $\frac{1}{50}$ second, $f/6.3$, 12mm extension tube

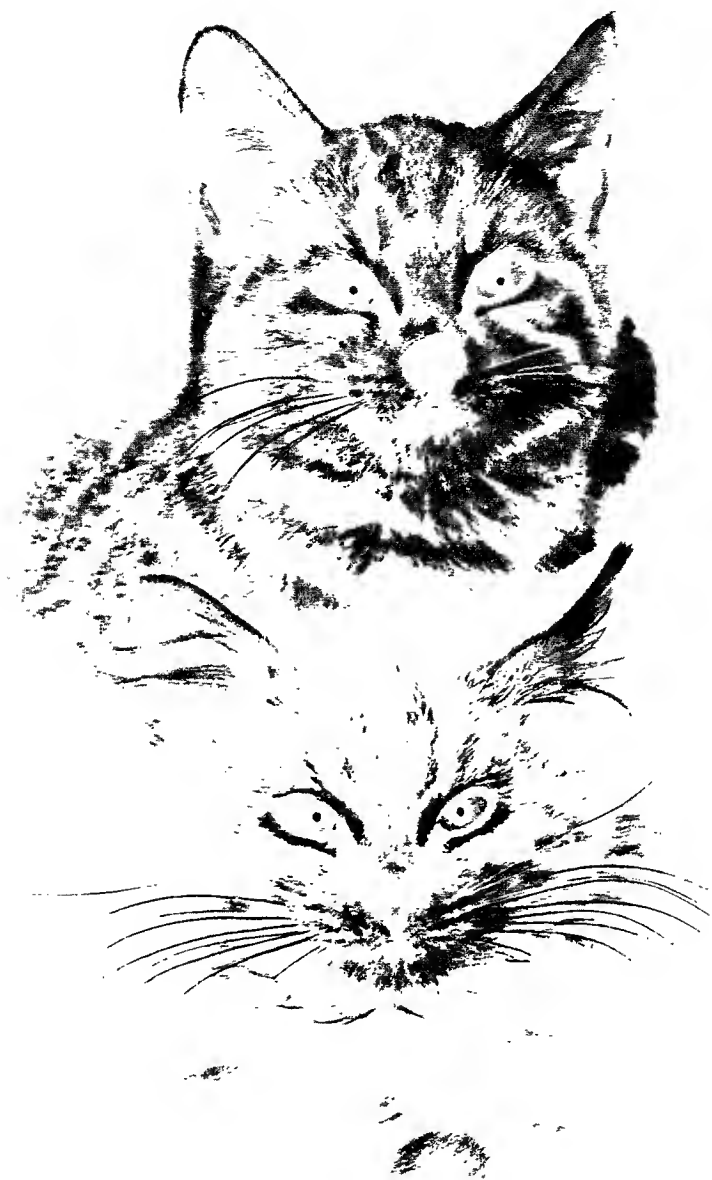
Burlap blind used to photograph Great Black-Backed Gulls. DATA: 35mm Elmar, $\frac{1}{50}$ second, $f/6.3$

Flight of Arctic Tern. This is an excellent representation of a bird in flight. DATA: 73mm Hektor, $\frac{1}{50}$ second, $f/2.8$

Nest of Common Tern. DATA: 50mm Elmar, $\frac{1}{50}$ second, $f/6.3$, 12mm extension tube

Gannet Colony. Bird Rocks, Magdalen Islands. DATA: 135mm Elmar, $\frac{1}{50}$ second $f/6.3$

All color photos by Albert W. Simmons



CATS

From a Kodachrome original

The photography of cats is of special interest to many. Read the story on this fascinating subject



USE OF INFRARED. This photograph at the left, of a rat embryo, was taken on a metallographic plate, while the one at the right is the same subject photographed with infrared. Notice that the infrared has penetrated the embryo better, and that it shows tissue structure. These photographs are magnified many times, and the actual head is .66mm in width
Photos, J. S. Nicholas

(Continued from page 424)

record the changes. If serial sections of an embryo are available, as many as desired may be photographed, the prints cut out and properly spaced to give a solid model.

Growth may be studied with the aid of good photographs. By enlarging all of the photographs to an arbitrary size the changes in proportion during growth are emphasized. Photographs for this purpose must be taken with the camera level and the lens pointed at the center of the subject to avoid distortion. It is desirable also to place a frame—marked in centimeters, inches, or other units—around the subject so that size may be measured directly in the finished print.

MORPHOLOGY AND TAXONOMY

No two organisms, except identical twins, are exactly alike and even twins may show some differences as they develop each in their own slightly different environments. Photographs showing the kinds and extent of variation are important to the biologist.

Clear photographs showing the essential details are necessary to illustrate descriptions of newly discovered and different species of animals. Perfect specimens should be used. In general a full view and several views of different sides and of special characteristics will be required.

Most invertebrate animals can repair considerable injury to themselves. Some may deliberately injure themselves to get away from an enemy. Brittle stars and

many crabs have special regions in the arms or legs where the appendage can be shed with little damage to the animal, which goes off leaving the would-be captor with only a wriggling arm. They then grow a replacement part by regeneration. Some worms can be cut into many parts, each of which will reform into a perfect whole. These processes may be illustrated and analyzed with pictures.

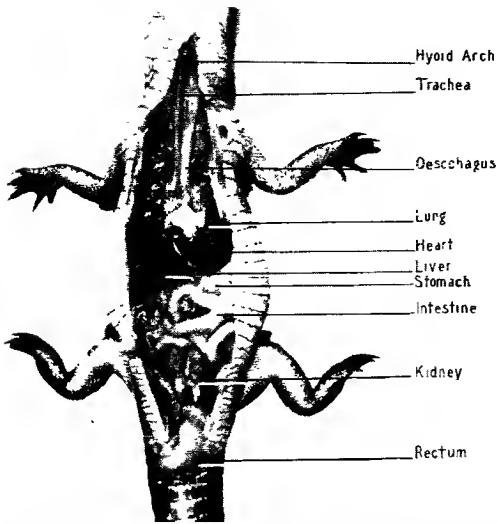
The analysis of form requires pictures showing the arrangement of the internal

organs, cellular organization, and finally the cytological organization of the cells themselves. The latter two are photographed through the microscope to obtain the finer details.

The reds and browns of diseased leaves can be separated in the photograph on a rapid panchromatic film with red filters. The Wratten Numbers 25 A, 29, and 70 give progressively increased contrast and require



DELINQUENT BRANCHING. This elm is shown to advantage before leaves are fully expanded. Filters are usually used with tree work and the results are often both scientifically and pictorially interesting
Photo, Oscar W. Richards



ALLIGATOR. Often much better than an artist's drawing is a photographic view of internal organs. In this photo a filter was used to make a contrast between the various sections
Photo, Silas Nourse

proportionately greater exposure. Overexposure should be avoided. Prints should be made on a contrasty paper.

PHYSIOLOGY

The physiologist has the problem of learning how the structure works. Without a knowledge of form little can be understood about function and vice versa. Some types of function can be shown adequately with successive photographs; others require slowed or speeded motion pictures. (Record photographs should be made of any special apparatus used in an experiment.) Very small details, such as the blood circulation in capillaries, may be as important as pictures of the whole organism.

Many special instruments record photographically. The spectroscope is one of the best known of this type. Others record energy and change with respect to time.

Motion pictures can be made of internal organ functions by means of X-rays. Infra-red radiation and plates sensitive to it are useful in photographing blood circulation, color changes in the skin, and surface spread of some plant diseases.

Procedures may be taught by means of motion pictures more effectively than by written articles. The film insures that each member of the audience has the best view.

details can be shown in proper perspective and the film repeated as necessary until all understand. When human judgment or interpretation are involved, the film can show various types of reaction and their proper grading. Still pictures may help when motion pictures are not available.

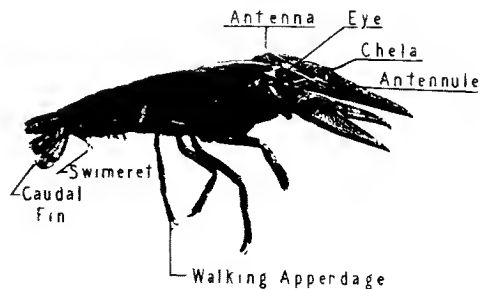
HEREDITY AND GENETICS

The geneticist measures and studies the inheritance of organisms and how they progress from generation to generation. The variations affecting form are easily recorded in a photograph and a series of photographs are of assistance to show what has been accomplished and aid in planning future breeding. The photographic problems are not different from those of other branches and need not be considered in detail. Color filters may emphasize differences in mosaic patterns and blending inheritance. If you are not the geneticist, be sure to know just what the picture is to record and what viewpoint is best before making a picture.

The bearers of heredity are the tiny chromosomes within the nucleus of each cell. Photomicrographs are necessary for these records. There will be an increasing use of ultraviolet photomicrography because these structures are quite opaque to certain wave lengths. The chromosomes are transparent to infrared, which may be used to record other details of the cell.

PALEONTOLOGY AND ETHNOLOGY

An interesting scientific adjunct to the discovery of a fossil is a complete photo-



CRAYFISH. Specimens which can be transported are much better photographed in the laboratory, where the exact position and the simple background can be planned
Photo, Silas Nourse

BIOLOGICAL PHOTOGRAPHY

graphic record, from the first view of the fossil, through the preparation to the final mounted and cleaned specimen. Unless such records are available much information is lost when the original relations are forgotten. Accurate photographs of the parts are of aid in reconstruction, especially when the specimen is incomplete.

The ethnographer has a similar problem. After a former human habitation has been cleaned he may need to know exactly where a relic was in the debris. Even though no one noticed this at the time, a good progress photograph may answer the question.

Fossils and other remains dug out of the ground may show detail that is very hard to photograph because of the intergrading brown and gray stains. Such objects may be sprayed simultaneously with ammonia and hydrochloric acid vapor which condenses on the surface as white ammonium chloride (*cf. sketch*). The layer is so thin that it does not hide surface details and makes possible good photographs. Use it in a dry room and just before making the exposure, as the white layer will not last long. Fine surface details may be brought out with a source of parallel light just grazing the surface. A white card on the opposite side will reflect back enough light to relieve the shadows without losing the detail.

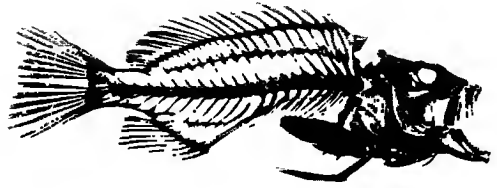
EQUIPMENT

The best equipment can be prescribed only when it is known what is to be photographed, where, and by whom. The photographer is more important than the equipment. Excellent equipment may be a handicap to a poor photographer. Budget considerations are important especially when a wide variety of subjects must be handled. Provision should be made to take colored objects with color film.

For photographs made within the studio, laboratory, or under favorable field conditions a 5 x 7 view camera is convenient. Separate lens boards should be available for the usual photographic lenses and for Microteleplats for macrophotography. The bellows should have a double extension and kits or sheaths should be available for 4 x 5 and 3½ x 4½ sizes. Some workers may be satisfied with the latter size alone. For straight

studio use, an 8 x 10 may be useful, but a smaller camera is more convenient to handle and it is usually cheaper to enlarge than to use large films or plates.

For general biological field work I personally prefer a 3½ x 4½ reflex type camera. They are small enough to carry easily and it is usually more effective to see what is to be taken on the groundglass than to use tiny



SEA BASS. Photography of skeletons is still another branch of biological photography. The skeleton forms of this black sea bass are brought out clearly by the use of a dead white background
Photo, Silas Nourse

finders and distance meters. Lantern slides can be made by contact, and contact prints are large enough for ordinary examination and use in the record notebook. There is detail enough for enlargements without such meticulous attention to fine grain. Again such a camera should have large enough bellows to permit close-ups at a few inches.

When one camera must be the sole instrument, then the versatile miniature cameras using 35mm film are the choice. They are easy to carry, fast, will make copies, photomicrographs, and do other tasks with suitable auxiliary equipment. The negative material is inexpensive and available in all types. On the other hand contact prints are too small for ordinary use and the photographer must enlarge everything except the color films and positives to be examined with viewers or projected onto a screen. More care is required to focus the camera exactly and to develop the film so as to obtain fine grain for the inevitable enlarging. The improved modern fixed focus and easily adjustable enlargers are almost as easy to use as a contact printer.

Probably the ideal equipment would include cameras of all three types. A changing bag may be made or purchased. The loading of film holders and developing tanks may be

THE COMPLETE PHOTOGRAPHER

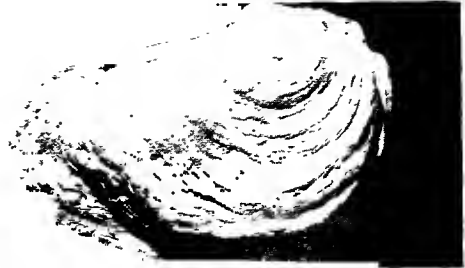
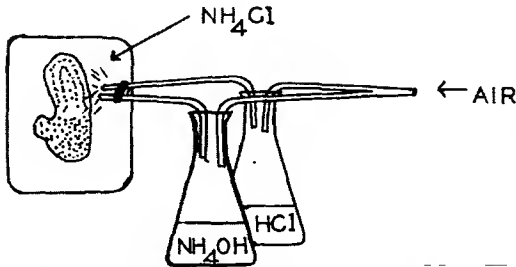
done anywhere, thus making the photographer less dependent on a darkroom. For field work it is essential. One can load film in one safely even though there is no shade within a hundred miles. Many an irreplaceable film has been saved by opening the camera in a changing bag and relieving the film jam which seems to occur occasionally with the best of cameras and operators.

The rest of the equipment depends on the kind of biological photographs to be taken

choice when the demands are not too great and economy of operation is important. Motion pictures should be taken when motion is an essential part of the record. It is a waste of film and a bore to an audience to portray a succession of still pictures.

TEACHING MATERIAL AND PUBLICATION

Photographs are used in biological science for teaching, to illustrate lectures and scientific publications, and for making the special



SURFACE-COATED SPECIMENS. To give the fossil bivalve (right) a more photogenic surface, a coating of ammonium chloride—condensed from ammonia and hydrochloric acid vapor—was sprayed on it (as at left). Such surface coats do not harm the specimen and make scrubbing unnecessary

Photo, Oscar W. Richards

and the proportion to be made in the field and in the laboratory. The biological photographer should be prepared to use all kinds of emulsions and to have color filters. When going to warm, damp, semitropical and tropical regions it is necessary to use materials prepared for these conditions. Unless absolutely necessary the photographer is advised against developing other than test strips in the field. It is preferable to properly repack the exposed materials and bring them back to civilization for processing. Before setting out on any field work the beginner is advised to pack his kit and try it out in the hills near home before departing for distant regions. The photographic equipment should be packed in its own cases, separate from other materials. A knapsack may be used to carry the camera and supplies. The smaller cameras and equipment may be carried in the usual photographic sidesack.

Motion pictures that are to be sold commercially must be taken on 35mm film according to professional standards. For purely biological use 16mm is more convenient and is large enough for teaching or scientific meeting requirements. The eights are invading the biological field and are the

knowledge available in museum and other exhibits. It is rare that a picture, still or motion, made for analysis or research study is not also useful with proper editing, for other audiences. Unless the full use is made of each picture, that much potential material is missed.

Exhibits use enlargements up to photographic size. Pictures may be the basis for an exhibit duplicating on a small scale a natural habitat. Good pictures of living organisms are fascinating and have a potential market in almost all newspapers and magazines. This is a way to pay for materials and to earn more equipment. Such pictures must be photographically excellent and suitable for the market. Send only what you think the editor wants and will use. Pictures for teaching and scientific use must be photographically good and faithfully show the biological information as well.

Twenty years ago arguments were heard as to whether drawings were better than photographs. The naive stated that pictures were preferable, because the drawing could only contain what the maker chose to put on paper, whereas the photograph was inevitably a faithful copy of the original. Now

BIOLOGICAL PHOTOGRAPHY

everyone knows that photographs may be controlled in many ways and even faked. After all, we must depend on the integrity of the scientist or photographer and a reputation is soon established. Both photographs and drawings have their special use in biology and it is often expedient to make a drawing from a photograph. This solves the problem of perspective for those who do not draw easily.

Such detail as desired is traced from the photograph or may be inked over on the photograph and the rest of the image bleached away. For the former method the paper may be held over the picture against a window if only a few details are required. If much work is to be done a light box will justify the effort of making it. All that is required is a box with one or more lights in it and a piece of ground, opal, or clear glass over it. A light in a moderately deep desk drawer and the glass over the drawer will suffice. Care to avoid heat damage to the drawer is advisable. Another method is to project the image with an enlarger and trace as much as is desired. Keys to the parts of a photograph are made from tracings.

If the detail is inked over on a photograph with waterproof draftman's ink the rest may be bleached in eight parts of water and one part each of (a) 120 grams of potassium ferricyanide dissolved in 500cc water; (b) 120 grams of sodium hyposulfite in 500cc water. After bleaching, fix in acid fixing bath and wash well. Blueprints can be bleached after inking with 10% neutral potassium oxalate (See *Bleach-Out Process*).

BASIC PHOTOGRAPHIC TECHNICS

The photography of organisms in their natural habitats has been discussed. When possible some known

measure of definite size should be included, preferably a ruler or meter stick. The surroundings should be cleared as much as practical. Photograph only typical organisms unless some abnormality or variation is called for.

The specimen should be brought into the studio when that is feasible, because it is easier to control lighting and convenient to have the usual facilities of the laboratory at hand. Backgrounds should be unobtrusive, provide the proper amount of contrast, and be far enough away from the subject to avoid confusing shadows.

A copying box consisting of a 2-foot-square piece of plate glass mounted on a frame is very useful with a vertical camera. Lights should be available from above and below and different backgrounds provided. Sometimes unusual backgrounds are useful. A purple card gave good results for monochrome rendering of the color patterns of the feathers of thyroid-fed fowls. The box frequently permits getting sharp outlines



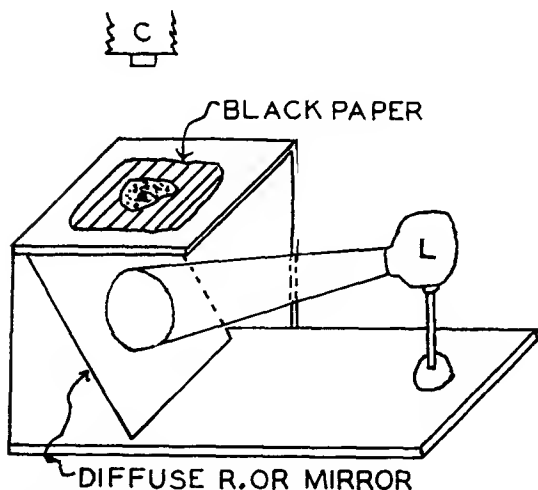
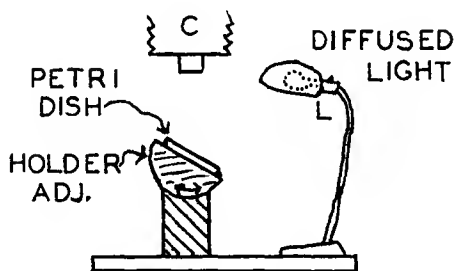
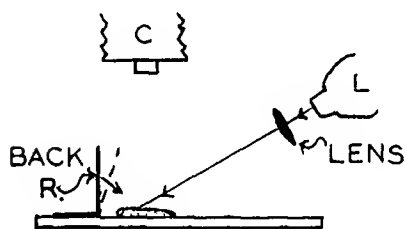
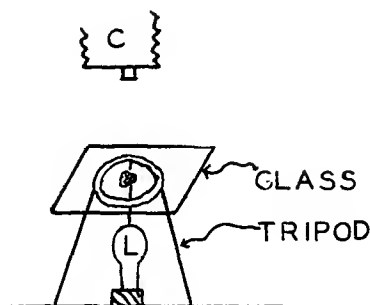
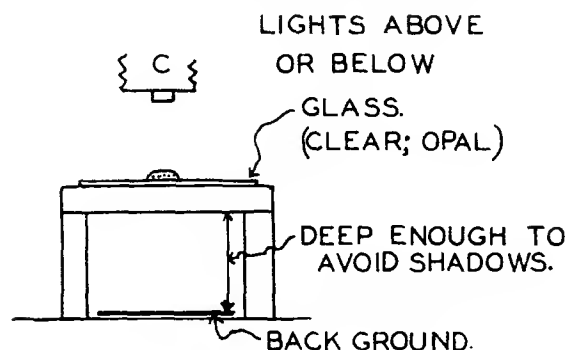
PHOTOMICROGRAPHY. A student using the photomicrographic camera with side-viewing telescope for convenient focusing. Notice the spotlight with filter directed at the mirror below the glass slide. This photomicrographic camera may be combined with any standard microscope and takes 3 x 4 film or plates

THE COMPLETE PHOTOGRAPHER

against light or dark backgrounds. When this is not possible the negative can be opaqued around the image or the unwanted detail bleached from the print with Farmer's reducer.

Aquaria frequently offer opportunities to photograph animals and plants in more or less natural surroundings. Large ones must be lighted to make the best of the conditions

found. Smaller aquaria may be made shallow enough to be within the depth of field of the lens and easily lighted. If a background or other organisms are provided, they should be appropriate. Running water helps clear the tank; likewise gravel and coarse dirt on the bottom help to prevent fouling the water. The water temperature should be within the limits tolerated by the



CAMERA = C
LAMP = L
REFLECTOR = R

PHOTOMACROGRAPHY

PHOTOMACROGRAPHY. Various methods of photographing very small objects with camera and extension tube or double extension bellows. In general, the 5 x 7 view camera is most satisfactory, although cameras may be slightly larger or smaller. Specimens should be brought into the studio when possible, as easier methods of controlling backgrounds and lighting are available with photomacrography

BIOLOGICAL PHOTOGRAPHY

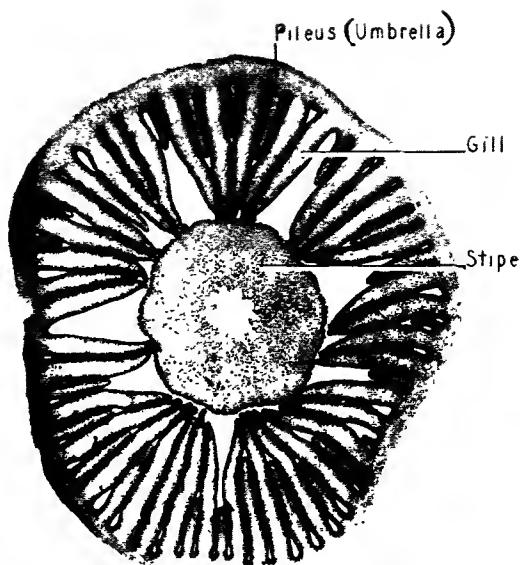
subject and overheating from strong lamps avoided. Some fish may be anaesthetized with 0.1% chlorbutanol and will recover in fresh water. It saves time to wait until the animals become accustomed to their new environment, even though it may take several days.

Invertebrate and cold blooded animals move slowly when cold, and a brief rest in the ice box may assist in keeping the animal in front of the camera long enough to get a lifelike picture. Covering others, like snakes, with an old hat or box, may quiet them so that a picture can be taken quickly after removing the cover. A bright light will temporarily stop the motion of many animals. Keep the animals comfortable and they will photograph naturally. Plants, insect larvae, amphibians, and many other animals are easily ruined by drying from the heat of flood lamps. Injury from this source must be avoided.

Photomacrography includes magnifications up to 50 diameters. The special lenses are mounted on the lens board, on extension tubes, or on a microscope with a wide body tube. Rack and pinion focusing should be provided. Success or failure depends on the care of lighting and beam-splitter viewing or a groundglass are essential. The sketches show various types of lighting. Insects, bacterial colonies, fungi, tissue preparations, capillary circulation in the tadpole tail, and many other biological objects fall into this field.

When higher magnification is necessary the microscope is used and a camera without lenses holds the film and provides control of magnification. Opaque materials must be illuminated from above with a vertical illuminator. Two types are available: one sends the light outside the objective to the specimen and the other inside the objective. For transparent preparations oblique light and dark field are useful. When the subject is colored best results occur with the natural color processes. Monochrome rendering requires a knowledge of color, the color sensitivity of the emulsion, and the use of the proper color filter. For further details see *Photomicrography* article.

Direct prints of leaves may be made on blueprint or chloride printing paper. Insects,



MUSHROOM CROSS SECTION. This photomicrograph shows extreme detail and is especially useful to the research botanist and the classroom instructor
Photo, Silas Nourse

flowers, fungus growths, and other biological forms where outline or shadow detail alone is satisfactory can be done by direct printing without a camera. Some materials will affect an unexposed film by chemical action when in contact with it in the dark and on development a surprising amount of detail appears. X-ray prints make interesting pictures and in some cases they are the only means of showing internal structure such as the growth rings in mollusk shells.

Apparatus is not difficult to photograph as no movement is usually involved. When the function must be shown, motion pictures are used. When it is built of glass or transparent plastics it may be well to use a dead black background and top- and backlighting.

Stereoscopic photography is easily possible with Polaroid filters even for projection before large audiences. This method adds a lot to biological photographs and it is well worth learning how to use. The two-camera method is easily accomplished with inexpensive box cameras. Or the camera may be mounted on a sliding bar and moved between exposures. The mounted prints may be viewed in a stereoscope, with special spectacles, or projected with a paired or a twin-lens projector.

DIFFICULTIES AND OPPORTUNITIES

Living organisms provide all grades of photographic difficulties. The beginner in the field can make satisfactory pictures showing how many organisms live. Others challenge the skillful. The pictures may be used for illustration, in teaching, and sold to many newspapers and magazines. Some of the possibilities have been suggested along with some of the specialized methods. Few fields offer greater possibilities for photographers either as a hobby or as a profession. It is a field where success follows knowledge, experience, and hard work.

BIRD PHOTOGRAPHY: PART I

William L. and Irene Finley

Ornithologists and co-authors of American Birds, Wild Animal Pets, Mr. Finley is vice president of The National Wildlife Federation, board member of The Outdoor Writers' Association

In this first of two articles on the interesting subject of bird photography, the Finleys tell of their many years' experience in the field with the camera. Here are some words of wisdom on the subject of blinds, equipment, bird types. The authors also tell of the interesting possibilities in life-history series.

All photographs by William and Irene Finley

See Also Animal Photography

CAMERAS were used before shotguns were invented. Yet it was the custom of people to shoot birds with a gun years before the first photographer began taking bird pictures.

As far as we know, the oldest photographs of birds in America were some pictures taken of gannets and other sea birds on Bird Rock in the Gulf of St. Lawrence in July, 1881, by Professor Alpheus Hyatt. Dr. Frank M. Chapman, Curator of Ornithology of the American Museum of Natural History, made his first photographs of birds in Florida in 1885. Some of the other early bird photographers were George Shiras III, Dr. T. S. Roberts, Florence A. Merriam (now Mrs. Vernon Bailey), the Kearton brothers of England, and others.

When the publishing of bird pictures started, it led others to begin hunting birds with a camera. During the past forty years

many bird books have been printed. Untold thousands of bird pictures have been reproduced in newspapers and magazines, and certain magazines are devoted entirely to bird life and natural history.

BIRD PHOTOGRAPHY TODAY

Today the field of bird photography has widened to cover a variety of phases: 1. still pictures that portray the life history of different species, including nesting places and growth of birds from egghood to maturity; 2. pictorial shots showing where birds live and how they act; 3. motion pictures with various purposes. Each of these fields presents untold opportunities to the photographer who is also an amateur or professional ornithologist.

The ornithologist-photographer may expect his profession to lead him to every part of the globe. We have cruised in the Gulf of Mexico, in the Pacific from the coastline of British Columbia to many parts of Alaska, and around the outpost islands of the Bering Sea. We have studied in many sections of the Southwest and packed into the highest passes of the Cascade and Rocky Mountain Ranges. We have exposed over 200,000 feet of motion picture film and made no less than 60,000 still shots.

Experiences we have had in this difficult but thrilling game may be of help to those photographers who are also interested in birds.

AFOOT AND IN BLINDS

The best way to begin bird photography is to get acquainted with birds and know their habits. Getting close enough for good pictures often takes long and patient stalking. It is best to find where the bird is nesting or where it may feed. In this case, the camera can be focused at a certain spot and then be partly covered, except the lens, with a green cloth; or it can be hidden among green leaves. With a thread, one can release the shutter at a distance.

The most satisfactory way of getting good pictures of birds is to construct a blind in which the photographer and camera can be hidden. Dr. Frank M. Chapman was one of the first photographers to construct and use a blind. He used a green umbrella, sup-

BIRD PHOTOGRAPHY: PART I



RUFIOUS HUMMINGBIRD. Caught in its nest, this extremely fast bird is easier to photograph than when on the wing

ported by a grass rod that could be driven in the ground. On the sides of this was hung a green or brown cloth. It was a good shelter tent, with a camp stool to sit on and a little

hole to peek through and watch the birds. When this was placed near a nest, the birds soon took it as part of the surroundings, and photographing was possible.

BIRD TYPES

There are spectacular birds that frequent the ocean shores and lakes, and equally strange birds that live in the interior, especially in the Southwest. One of these might be described as a long-tailed, crested cuckoo, but is known as the road-runner. He has other names, like the "chaparral cock." He doesn't fly very much, but can speed across the desert floor at the rate of about 25 or 30 miles an hour. Where the cactus plants are abundant, he seems to prefer to nest in a cholla, because it is so covered with long sharp thorns that his enemies are not likely to get the young birds.

The road-runner is one of the shyest and wariest birds of the desert. He hides from intruders not merely his nest, but himself. After careful hunting, the photographer may discover his home, but seldom will find him in it. His yellow eye is ever watchful; he sees any movement and becomes a fleeting shadow, lurking cautiously in the dim background, anxious and curious but fearful.



LAPWING AND EGGS. The blind shown at the left was used to get this picture of the lapwing protecting its eggs. The upturned camp stool at bottom right of left-hand picture marks the position of the eggs and shows how close the blind can and should be to the subject. DATA: 1/11 second, f/11

Photos, Ian Thomson



BLUE HERON. Unlike many birds, the blue heron is not particularly shy and will stay in one pose for a long time. A small stand was erected for this shot, so that the most artistic viewpoint could be had. With a telephoto lens, the exposure was 3 seconds

Sometimes he hides before one's very eyes, standing stiff and straight under a cholla cactus, with not even the movement of an eyelid, undoubtedly with that intuition of the wild creature that "freezing" is his most impenetrable cloak. If one catches his eye, he scents discovery, settles low to the ground, slips away and fairly melts into the sand.

The road-runner is such a shy creature that a blind is necessary. Since the sahuaro or giant cactus was found near the road-runner's nest, we built a blind resembling the trunk of this cactus. It was just large enough for a person to stand inside and there was a little hole in the front for peering out and also for the lens of the camera. Although it was eight or ten feet high, one could lift it up and move it where needed. The road-

runner was not afraid of this cactus plant, so we were able to photograph within a few feet of the nest.

Some birds are much easier to photograph. The attitudes of the great blue heron at rest is in itself artistic. While photographing a colony of these birds in the San Francisco Bay region, we hunted for several days to select a position that would have an artistic make-up. The best one we could find was in the outermost branches of a tall sycamore. The only viewpoint for the camera was from the top of an adjoining tree. At this place we had to erect a small stand and tie the camera in position. The distance was too far for the regular lens, but with the telephoto attachment a good picture was secured after the old heron returned from fishing and perched on a dead limb at the side of her nest. It was a 3-second exposure.

Few baby birds are more cunning than a wild duckling. No bird is so quick of movement within such a short time after he emerges from the shell. When only a day or so old, he is capable of following his mother about in the marsh and getting his own dinner by capturing flies and other insects. This is another hard one to photograph.

COMPOSITION OF BIRD PICTURES

Since the art in a nature photograph is so greatly limited by the working possibilities of the camera, how much the skilled painter has it over the photographer! The painter may place his heron on one side of the river or the other, plant his trees just where they produce the best effect, and make the water ripple or reflect, flow east or flow west.



THE ROAD-RUNNER—AND THE BLIND. The photograph of these two young road-runners caught in the act of swallowing lizards is remarkable, as they are such shy birds. The cactus with legs, shown at the right, is the weird blind used to get this close-up





PINTAIL DUCKLINGS. A wide aperture and short depth of field have kept the ducklings in focus but thrown the surrounding marsh into a mysterious blur—highly effective for a pictorial shot. Much space has been left around the young birds to emphasize their smallness

When the enthusiast with the camera tries for these effects, he has to search for his foreground and background. He has to move to suit the light, not move the light to suit himself. Even if he selects a good position, his bird and animal subjects are likely to be missing. He may try for days and weeks and not succeed in getting a combination that will make an artistic picture.

In wild life photography, one generally has to take what he can get. Yet this is not always so. The photographer may often obtain photographs of artistic value by combining a technical knowledge of the camera with a sympathetic study of nature. He may sometimes select his position and his subjects; if he has the patience to wait hours and days he can get the make-up of his picture. This we did in the case of some Caspian terns nesting on a tule island in Lower Klamath Lake. We set our cameras, carefully concealed in a blind, to get a small bunch of tules in the foreground and the lake in the background. With this composition for a picture, we exposed twenty plates, of which only one was successful.

In Southern California we tried for days to get a combination picture of gull, clouds, and waves. Both gull and waves were moving so rapidly that the highest speed was necessary. The distance between the two objects made it impossible to get both in focus at once. With the bird near enough at hand to show clearly, one had to forfeit the clearness in the balance of the picture. Whenever the waves were breaking just right, it was almost impossible to catch a gull in the right position, and vice versa.

EQUIPMENT FOR BIRD PHOTOGRAPHY

In getting wild bird photographs, one should have at least two good cameras. One of the reflecting type with a rapid lens is necessary, because many of the bird pictures, especially those of flight, have to be taken with an exposure up to $\frac{1}{1000}$ second. But the reflex camera with rapid lens has some disadvantages too. One often has to forfeit depth of field. And in a very rapid exposure, one seldom gets the light that is necessary to give clearness and density which is essential in a good photographic plate.

For artistic results in wild life photography, we always prefer the long-focus type of 5 x 7 camera with an ordinary rapid rectilinear lens. The best results can be obtained where the composition can be studied, where there is even light, and where a time exposure can be given.

BIRD PHOTOGRAPHY AIDS CONSERVATION

One of the most valuable by-products of our interest in bird photography has been the progress in wild life conservation that it has encouraged.

In the Spring of 1905 we made a trip to the lake region of Southern Oregon and Northern California where western grebes, white herons, and other birds were being killed for millinery purposes. Ducks and



PHOTOGRAPHING YOUNG PELICANS. While the bird photographer has to build complicated blinds and wait long hours for some birds, others can be approached easily. Here the author focuses on a close-up of white pelicans, who apparently find him an interesting spectacle

geese were being shot during the fall and winter, and about 120 tons each year were shipped to San Francisco markets. We hoped to stop the killing of so many birds.

It was difficult to make a study and a good series of photographs. We had to take a heavy load of camera and camping equipment. Seven cases of 5 x 7 plates added a lot of weight. With a light rowboat we cruised around Lower Klamath and Tule Lakes for about two months. If we could have used films instead of plates our load would have been much easier to handle, but we would not have had as fine a series of pictures. Today these negatives are clear and in as good condition as when taken. From a photographic point of view this trip was a great success.

Again in 1908 we set out to explore Malheur Lake in Southwestern Oregon. At that time this was perhaps the greatest waterfowl area in the West. Here we found large colonies of white pelicans, ring-billed and California gulls nesting near together, great blue herons, and Farallon cormorants, white-faced glossy ibis,



CASPIAN TERNS. On the shores of Lower Klamath Lake this well-composed bird picture was taken. The photographer waited long hours for this one—the best shot in 20 exposures. But with composition and beauty of line as a result, the long wait was worth it

BIRD PHOTOGRAPHY: PART I

black-crowned night herons, western and eared grebes, and three species of terns. When President Theodore Roosevelt was told about the great bird colonies in Oregon, and had seen our pictures, he issued three Special Executive Proclamations, setting aside Three Arch Rocks, Lower Klamath Lake, and Malheur Lake as Federal wild bird reservations. Thus, good photographs proved to be of great importance, not only



STALKING THE MURRES. Working around the sea cliff to a ledge beyond, for a photographic vantage point, are the author and H. T. Bohlman. Bird photography is no easy pastime, and cliff walls or high trees often have to be scaled—with bulky equipment at that

in educating people, but in bringing about the needed action for bird protection.

LIFE HISTORIES: RED-TAILED HAWKS, GOLDEN EAGLES, CONDORS, QUAILS

One of the photographer's greatest contributions to ornithology is the picturing of life histories of different bird species. After our first visit to Three Arch Rocks, in 1901, where we watched and photographed the great bird colonies, we were anxious to portray a more complete life history of a bird from egghood to maturity. The plan was to find the home of one of the larger birds of prey that had a unique setting in a tree or on the side of a cliff.

Finally we found the aerie of a red-tailed hawk, far in the top of a tall cottonwood. The tree measured over fourteen feet around at the bottom. The first limb was forty feet above. The nest, occupied for years, was a hundred and twenty feet up. Fifteen feet away was a smaller cottonwood that we thought would serve as a ladder. We chopped at the base of this and pulled it over with a rope. Fortunately its crown lodged in the branches of the nest tree. With climbing irons we reached the first limb of the old cottonwood and lassoed the branch above with a rope. Then we worked slowly up. We strapped the camera in the crotch of a limb opposite the nest. To focus, we had to strap ourselves to the tree limb and dangle out backward over the brink.

The first picture of our series was made on April 15, 1902, before the tree had leafed out. The next picture of the two young red-tails in the down stage was taken May 3. By the last days of May the pair of hawks was pretty well grown. The last



HAWK NEST. This detail, one of many in a life-history series of the red-tailed hawk, shows the intricate construction and sturdy material of a nest. Subsequent pictures were taken to show the eggs hatching, the young birds growing and learning to fly



YOUNG GOLDEN EAGLES. One of a life-history series, this photo shows two mottled eagles at the age of 40 days. The author had little trouble taking periodic shots such as this, as a permanent platform near the nest was built

picture was made in June. Even though we had made a series of life pictures of these birds during five hard trips, we had been unable to get a shot at either of the parents bringing food to their young.

Two years later we discovered the nest of a golden eagle on the rim of Mission Ridge east of the San Francisco Bay region, high up on the spreading branch of a sycamore tree. In the topmost branches of an adjoining tree we put up a little platform where the camera was fastened and aimed downward at the aery twenty feet away. A good series of lenses is needed when photographing in the tree top. By adjusting a wide-angle lens, we got a view of the nest and surrounding limbs, and at the same time the depth of field in the picture showed the outline of the valley lying miles below. Three other lenses produced nearer views. A telephoto lens



YOUNG GOLDEN EAGLES, AT 55 DAYS. In the last 15 days, a remarkable growth is seen and it is such information which is useful to the ornithologist. Here the eagles are not ready to fly, but they have the characteristic darkened feathers

brought the nest as close as needed, covering the full size of a 5 x 7 plate and showing both the young eaglets and a clear picture of their home.

It had often been said that an old eagle would show fight and even attack a person near its nest and young. Each time we visited this bird home, the parents silently disappeared. One might think that a noble bird like the eagle was cowardly when it forsook its nest and young. Perhaps years of persecution by gunners led them to mistake a camera for a gun. But during six long trips extending over two months and a half, we failed again to photograph the parent birds.

We were still in search of a complete life history in photographs of a striking bird



EAGLE AERIE. The author and H. T. Bohlman are shown here at the young golden eagle's nest on Mission Ridge near San Francisco. Notice how close the photographers are to the young eagles; notice, too, the view of the valley far below

family. We were hunting in Southern California in 1906, hoping to find the largest bird of prey in North America, the rarest and the one with the most limited range, the great California condor. As luck would have it, assisted by two nationally known bird lovers, Joseph Grinnell and Walter Taylor, we found a condor's home in a cave in Eaton Canyon, which is in the Sierra Madre Range. It had never been pictured. History showed this was another bird on the brink of final disappearance. We felt the value of the cameras was to record the life history of this vanishing species, so we mapped out the plans.

There is a remarkable difference in size between a sparrow and a condor and also a difference in the time of development. From

BIRD PHOTOGRAPHY: PART I

egghood to a flying stage, a sparrow is on the wing in about fifteen days. The period of growth in the condor takes about one hundred and eighty days.

In the camera study of the condor family, the mother had deposited her large bluish-white egg about February 22nd. We pictured the downy, white nestling on March



EAGLE PORTRAIT. This young eagle is one of a dying species. Not particularly predatory, the eagle eats squirrels and rabbits—and does not deserve the wholesale slaughter it receives at the hands of people who shoot with guns, not cameras

23rd, the day after he was hatched. His head was flesh pink and bald like his mother's. At the age of thirty days, he was more than doubled in size, and his downy coat had changed from a pure white to a soft gray. He was still in the downy stage and weighed six pounds when two months old. At three months of age the wing feathers had pushed through and his weight had increased to ten pounds, but his breast and back were still downy. It was not until he was five months of age that he was fully feathered. On account of his increased



CONDOR CHICK. This, and the succeeding four illustrations are taken from a life-history series. As there are very few condors in existence—some 50 in the State of California—such photographs are valuable. This one shows a one-day old chick, hatched in a cave in the mountains of Southern California

weight and the slow growth of his wings, he was not able to fly until about six months old.

The old condors were thought to be wary and ferocious, but this pair had the opposite attitude of all other birds of prey. After eight long mountain trips to the condors' cave, there was the most remarkable companionship between bird and man. Several times the mother came up and nibbled at the hand of the cameraman. Photographs were taken of both the old condors at a distance of from 4 to 6 feet. The implicit trust they placed in us had brought a kindly feeling for what seemed the most striking characters in all bird history.

We took the young condor home with us and he became quite a pet. After a study of seven months, we took the last series of pictures showing this bird as a finished study. He then made his second long railroad trip to the New York Zoological Park where he



CONDOR—54 DAYS OLD. Weighing about 7 pounds now, this young California condor has begun to turn gray and wing feathers will begin to push through soon. This baby bird was given by the author to the New York Zoological Park, where it lived for 9 years

had plenty of room for exercise, wholesome food, and another condor as a companion. However, he lived a little less than nine years. At the present time, only about fifty condors are left in the State of California. It looks as if these photographs were to be the epitaph of the species.

One of the simplest, most satisfactory ways we have of securing a good series of bird pictures has been to find baby birds, lost or deserted, and to bring them to our home. For many years it has served as a shelter for bird orphans.

A day-old California quail was once brought to us by school children from across the river. It did look like good luck to get a bird's history from the very beginning and follow it through. He was housed in a box in our study, which was furnished with a



MALE AND FEMALE CALIFORNIA CONDOR. Condors, "the most striking characters in all bird history," are shown here in an affectionate pose

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warm wool nest in one corner, some hard-boiled egg for food, a little tin of water, and a pasteboard box of fresh dirt for a bath. He paid no attention to any of these, but seemed petrified with fear. The first evening he looked cold and miserable. Then we attached an electric reading lamp near the box and placed it so the light shone down on the little bird. It was no time at all until the bedraggled quail began basking under the warmth of the lamp. From that time on he accepted the warm light as a mother.



CONDOR IN FLIGHT. Flight pictures or wing shots such as this are extremely useful, as well as beautiful. They tell the position of the tail, the feet, and they show how the wings and wing feathers are used

It was not until later that he learned to eat the artificial food offered him. The yolk of an egg took the place of insect food. After that he was always furnished a supply of bird seed, lettuce, or chickweed, and at times he liked a raspberry or strawberry. A quail always prefers a dust bath. For eight years this quail lived about the lawn and in the garden, followed us around daily, and gave us unique picture opportunities.

FUTURE OF BIRD PHOTOGRAPHY

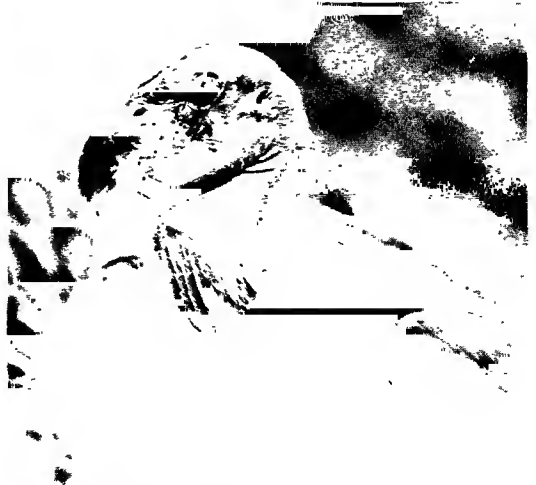
While working in the field for many years to get bird pictures, we were always im-



BARN OWL AND FIELD VOLE. A 12-foot blind was used to get this owl at his nest in a tree stump. The bird is shown here returning with a captured field mouse in his beak. The common owl is a bird which amateurs can often find and photograph. DATA: $\frac{1}{50}$ second, f/4.5

Photo, Ian Thomson

pressed by the beauty of colors. However, all this was lost in the picture. Today, color photography opens new horizons for bird photographers. Change and improvement in motion pictures has opened a wonderful new field. The improvements and progress of exposure meters that are needed for colored pictures, the manufacture of different cam-



CONDOR PORTRAIT. After the author had made 8 trips to the condor's cave, the parent birds became very friendly. This portrait was taken at a distance of 4 feet

BIRD PHOTOGRAPHY: PART II

Albert Dixon Simmons

Ornithologist, Author of Wing Shots, Flight's End

eras, equipped with modern lenses, the various sizes of transparencies like Kodachromes, the colored prints that are produced—all these are revolutionizing photography. The future for bird photographers is a bright one.

For photographers who have always felt a fascination for birds and who have always had a desire to know more about them, bird photography is the thing. It is fun, it is exciting, hard enough but not too difficult. It is, moreover, a useful occupation, for ornithology will probably never get enough action shots of birds or studies of nest life.

If a photographer goes into the photographing of birds as a profession, there is ample opportunity for the modern Audobon. It is a fascinating business, which can take you from the cold of Alaska to the heat of the Equator—if you wish—or merely into the trees and fields of your own backyard.

Action photographs, color work, and motion pictures of birds are covered in this article. Flight photography is difficult and the author has some interesting words to say about the use of the miniature camera in this work. A table of wing beats per second is given so that wing shots can be taken. And the new subject of bird pictures in color is covered.

See Also Animal Photography, Telephotography

BIRD photographs fall inevitably into two groups: 1) activity at the nesting site; 2) away from the nest behavior.

In the first group we find the closest approach to a still in bird photography. For example, a nesting woodcock will remain frozen for hours at a time and I have ac-



COLONY OF MURRES. This group of California mures was photographed on Three Arch Rocks, Oregon Coast. While it is often hard to get within range of these colonies, hard to find their meeting-places, once there the photographer can photograph birds by the hundreds

BIRD PHOTOGRAPHY: PART II

tually set up mirrors to throw a much needed spot of sunshine into its home, snipped off stray grasses within an inch of the bird's bill, then obtained a close-up with the use of a 135mm telephoto lens from a distance of only 5 feet. During all my activity, I failed to see the bird as much as wink an eye. Such a nesting scene is the really easy still, if you have found the nest of a woodcock. One noted ornithologist has made the statement that after forty years of bird hunting, he has yet to find his first woodcock nest.

To this first group belong the great bulk of our bird photographs, for having once located the nest, the routine of setting up a blind is comparatively simple. It is interesting to note that in one recent Nature Photography Salon, the instructions read, "Photographs of birds taken away from their nests are preferred."

In the second group, stalking supplants the blind. Here, the stealth of the Indian, the "squeaks" and bird imitations become an intimate and thrilling part of the bird hunter, as they were indeed the methods of the bow and arrow hunter. The greater yellow-legs can be whistled in to alight almost at one's feet; geese and ducks decoy to clever imitations of their language; the "squeak" that many bird men know so well, will bring the wary thrush from its hiding place in the thickets and often reveal the presence of other birds that would otherwise go unseen. This kind of picture constantly demands quick action. Here again the minicam comes into its own, producing the quick shot that often makes the trip a success.

Never can too much emphasis be put on the ability of the cameraman not only to move in *slow* motion, but to have the patience to freeze for indefinite periods. Sharp as the eyes of birds may be, it is the movement of an object that the bird sees first. Hawks have been seen to loose their quarry when it dove to the grass and remained motionless, and birds will carry on with their daily duties in the presence of an immobile man.

SHOOTING THE ROLL

Someone has said that if a picture is worth the taking, it should be worth a dozen or

more studies, even under studio conditions. When we have our portraits made, we are never content with just one proof although we posed for each one of them. Birds are notorious for their fast movements, glaring at the intruder for a split second with first one eye, and then with a lightning-like twirl of the head bringing the other eye to bear. In doing this they upset all light calculations, for their bodies may be in shadow one instant and out of it the next. A careful



THE COMMON TERN. The bird at the left is bringing a worm back to the nest and the other makes a beautiful picture as it settles to a landing. An interesting shot of bird "home life." DATA: 35mm camera, 135mm lens, fast pan film, $\frac{1}{500}$ second, f/6.3
Copyright, Albert Dixon Simmons

study of these movements is one of the first and best rules in bird photography because the characteristic movements of birds are repeated. Knowing this, the photographer studies the attitudes; the advice is then to shoot the roll. Out of the series will come the perfect picture, or better still, a series of good poses that truly catch the bird personality.

The minicam with its 36 exposure roll, requiring only the twirl of a knob to set the shutter, move the film ahead, and count the exposure, has the advantage for such work and it must be remembered that there is no great film expense as would be the case with cameras taking larger pictures. Another advantage that goes hand and hand with the series studies, is the possibility of picking out the negative that makes for composition sense. Since birds are comparatively small photographic subjects, a mere fraction of the negative may contain the elements of good



WILD WHISTLING SWANS. The photographer waited two successive seasons for this shot and finally caught these elusive wild swans in a graceful pose, full of movement. Bird photographers must have an almost infinite amount of patience, but they are occasionally rewarded by pictures such as this one. DATA: $3\frac{1}{4} \times 4\frac{1}{4}$ Graflex, 15-inch Dallmeyer telephoto lens, fast pan film pack, $\frac{1}{400}$ second, $f/8$
Copyright, Dell Mulkey

composition. To make the necessary enlargement, only the perfect negative can be used.

OFFHAND

With the improvement of film came additional emulsion speed as well. This, coupled with the high speed lenses available for the 35mm camera, produces a twofold advantage: 1. fast shutter speeds can arrest action; 2. it disposes of the cumbersome tripod, for with fast shutter speeds the camera can be hand held even when using telephoto lenses. The longer the focal length of a lens, the more difficult it is to hold the camera still by hand. Since the standard focal length of the 35mm camera lens is only two inches, a 6-inch lens gives a three power telephoto effect, while a camera with a standard focal length lens of 5 inches would require a 15-inch lens to produce the same telephoto value. In this fact we have an outstanding advantage

for the miniature camera in nature photography and one rarely mentioned.

WING SHOTS

Today the world is flight conscious, as it must have been twenty-six and a half centuries ago when the Psalmist pondered "the way of an eagle in the air." Making flight studies of our birds is one of the most difficult of photographic assignments, but it carries with it all the thrill of the hunt. Literally hundreds of pictures must be taken for the mere handful that will be printable.

Flight pictures must be done with telephoto lenses or the images of the birds will be too small to permit satisfactory enlargements. The problem is to get the bird in sharp focus because of the depth of field limitations of the telephoto lenses. Then to make the problem still more difficult, waterfowl for example, skim through the air at

BIRD PHOTOGRAPHY: PART II

from 60 to 100 feet per second. Changing the ranges so fast that lens adjustments, if they are made at all, must be done in a split second—that is the photographer's job.

With luck, birds on the wing can be followed in the viewfinder, but more often they are well on their way before they can be picked up. Open or sport sights—the kind used by news cameramen—are a great help in finding the bird in the sky. Elaborate, and very expensive gun cameras have been designed for shooting sport scenes and they have certain advantages for obtaining wing shots of birds, but I prefer the simplified version of the gun camera that I have used with good results for several years. It consists of an old gun stock or plywood gun stock form attached to the base of the camera by the simple use of an Eastman omnipod—clamped to the plywood and screwed into the tripod socket of the camera.

The butt of the stock is fitted to the arm and the proper length determined by trial and error. A 6- or 7-inch tube with open pistol sights mounted on the top of it, as if on the barrel of a gun, is the sighting method. This tube is fitted with a base that slides into the viewfinder slot on the top of the camera.

You now have a gun camera that can be dismantled in a few seconds for convenience in packing, and sighted like a rifle. The bird is followed in its flight and the shutter released in the usual way, but while the camera is in motion. By panning the bird in this way, the forward speed is arrested and a shutter speed of $\frac{1}{500}$ second stops the wing action of most birds.

The degree to which the wing is stopped depends on the number of wing beats per second that the particular bird is using. Here are some timings made from ultra slow motion flight studies:



SPRING MORNING. Here are Canada geese and mallards photographed during an early morning migratory flight. An excellent silhouette action shot. Notice the suggestion of clouds in the background and the treetop in lower left. DATA: 35mm camera, 135mm lens, fast pan film, $\frac{1}{500}$ second, $f/6.3$
Copyright, Albert Dixon Simmons

THE COMPLETE PHOTOGRAPHER

Osprey. . .	3 wing beats per second
Great horned owl. . .	3.5 wing beats per second
Blue goose. . .	5 wing beats per second
Willet.	6 wing beats per second
Pintail duck. .	8 wing beats per second
Blue-winged teal. . .	11.5 wing beats per second
Pheasant . .	12.8 wing beats per second
Hummingbird (hovering) . .	50 to 55 wing beats per second.

The first step in flight photography should be a thorough study of the flight behavior of the bird subject. The sharp-shinned hawk shown in the accompanying photograph could be coaxed into a power dive over my head by the use of the bird "squeak." It did this because I happened to be within a few feet of the tree where it had its nest. The maneuver allowed me to make a series of pictures out of which I was most fortunate in catching the hawk at the moment it came out of its dive.



SHARP SHINNED HAWK. This bird was photographed by the author from a tree near to a hawk's nest. It shows him coming out of a "power dive"—an unusual action picture. Notice the transparency of the wide-spread wings and see, too, how the blurred background adds to the motion of the picture. DATA: 35mm camera, 135mm lens, fast pan film, $\frac{1}{500}$ second, $f/4.5$
Copyright, Albert Dixon Simmons

Stop-action flight pictures of a hummingbird require a speed of about $\frac{1}{1500}$ second.

The position of the bird's wings at the moment of exposure has a great deal to do with the results obtained because at the top and bottom of the wing beat, the wings are moving at their slowest.

Birds, like planes, take advantage of the air currents and their take-off and landing is usually against the wind. Thus if waterfowl are the subjects, a check of the wind will determine a vantage point for the blind over which the birds will land and take-off. As an aid to judging distances in split second

BIRD PHOTOGRAPHY: PART II

time, it is well to establish known ranges by checking with the built-in range finder—the distance to a rock, tree, or top of a bunch of cattails. When the birds swing over or near the known ranges, a quick lens adjustment can be made in anticipation of the probable line of flight.

Our bird books are handsomely illustrated with artist's conceptions of birds on the wing, but the wing is faster than the eye with the result that most of the drawings are inaccurate. Bird study is now on a highly scientific basis and documentary photographs of birds in flight are needed to add to our ornithological knowledge and serve as source material.

COLOR

In this medium there are unlimited possibilities for the bird book illustrations of the

future. Although birds have been well photographed in the past, the development of color film makes the field an open one for the cameraman using color. The outdoors has been brought indoors for nature study work; the singing highlights and subtle color gradations of the living habitat group are displayed that all may see and enjoy the art that pre-exists in nature.

The principles that govern black and white photographic compositions no longer hold. We are now dealing with masses of color, and light must be studied with the utmost care. From sunrise to sundown, the quality of the light from the sun varies with respect to an object on the earth. Due to the filtering out of most of the blue, violet, and some of the green and yellow, the subject is flooded with a preponderance of orange and red at the beginning and end of



HERRING GULL. Amateurs have many chances to photograph the gull—especially from shipboard or on a wharf. Here is a gull shot taken by one who knows how. Notice the soft outlining of the wings, the pleasing effect of the cloud formation at upper left. DATA: 35mm camera, 135mm lens, fast pan film, $\frac{1}{400}$ second, f/6.3
Copyright, Albert Dixon Simmons

the day. Fog and clouds that hide the sun affect the color rendering of birds so drastically that sunshine is really a must for this kind of color photography.

At noon, the highlights in nature are so harsh that good color pictures are most difficult to obtain—the top of a bird's head is flooded with bright light while the throat and breast are in deep shadow. The contrast is too great for the range of the color film. If one exposes for the highlights, the shadows will be too dark, and if exposure is made for the shadows, the highlights will be burned out. Flat lighting is, when the sun is not overhead, the ideal. The two or three hours following sunrise and before sunset, depending on the time of year, are the best. But an allowance of one hour for the sun to rise and an hour to set must be planned to avoid the excess of orange and red already mentioned.

The sky also varies from gray-blue at the horizon to the blue of the zenith or overhead. The northern sky is bluest. If you wish to have a beautiful azure sky behind that bird on the limb, take the picture into that part of the sky—the north. In the same way, the blue of the sky as reflected on the surface of the water is bluest when the photographer faces the north.

One of the greatest difficulties in photographing birds in color, is that the color film is comparatively slow. Although the fast lenses of the miniature camera come to the rescue, many exposures will be lost on account of the movement of the subject. Flight photography in color is still handicapped by the slow speed of the film; $\frac{1}{200}$ second exposure at a lens aperture of $f/3.5$ is about the limit. Such a shutter speed is not fast enough to get consistently good results and fast telephoto lenses become rather cumbersome and expensive even for the minicam.

There are a great many ways that color photography can contribute to our store of bird knowledge. For example, many birds' eggs lose some of their subtle colorings after they have been blown or their contents removed by the collector. Accurate color pictures made in the field will not only show the eggs in their true colors, but a series of pictures will show the location of the nest

with respect to the surrounding landscape, and the interesting architecture of the nest itself.

Among the problems that confront the bird taxidermist today is the mounting of the bird in lifelike poses. Perhaps even more important is the necessity of retouching the colors of the bird that faded with its life—the bill, feet, eyelids, wattles, and other skin processes all begin to lose their natural color as soon as the bird is dead. Again, as soon as the bird is killed, the fall alone disturbs the natural position of its feathers and the taxidermist is often compelled to guess their true and intricate pattern. Black and white photographs are used as a guide in such work, but color photography brings the color and stance of the living bird to the printed page and the classroom alike.

COLOR PORTRAITS

With its retouching and glass eyes, the most artificial part of the mounted bird specimen is the head. This suggests a most interesting photographic field—the color portrait—and about the only way it can be done is from hand held birds during banding activities.

Close-up attachments must be used and the focusing done either on groundglass with the use of the sliding focusing attachment made for the 35mm camera, or better still the auxiliary device consisting of a clamping ring that fits over the lens of the camera. Attached to the clamping ring are four legs that point the four corners of the picture area and the plane of focus. The bird portraits in the color print section were made with the latter device and a 12mm extension tube between the 50mm lens and the camera. This is one case where the subjects can be arranged for background and lighting. The results are living portraits, valuable as field identification guides and intimate records of the true colors.

BLINDS AND CAMOUFLAGE

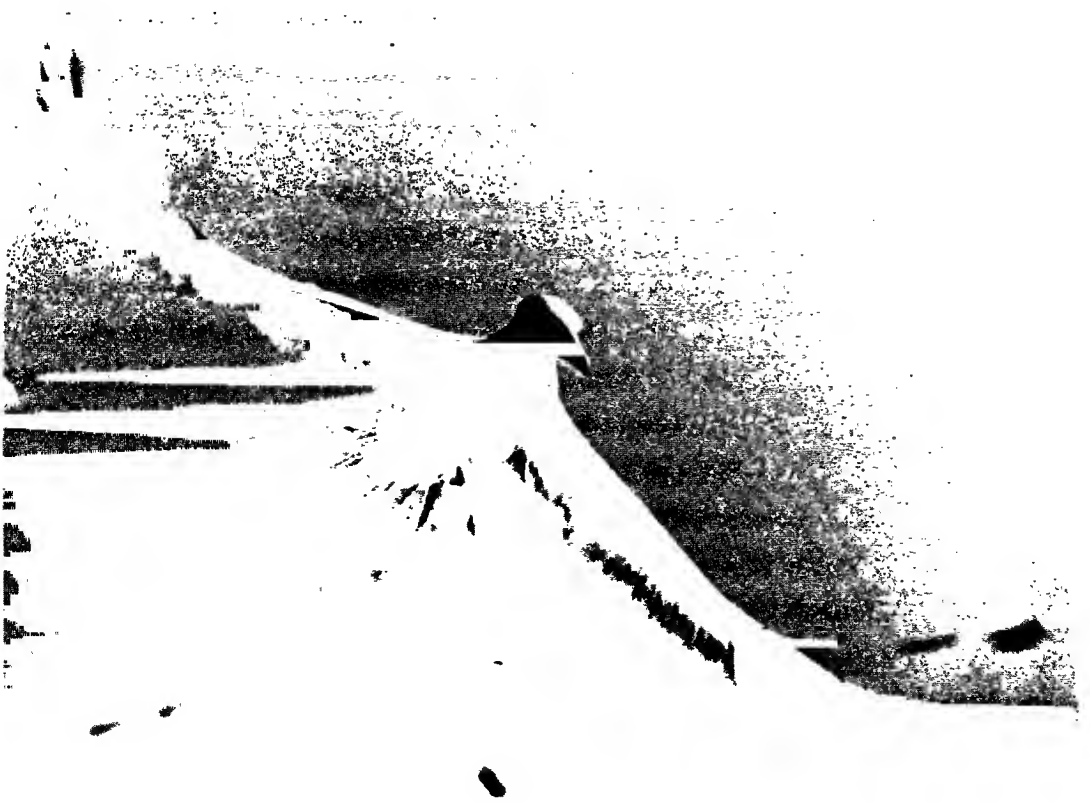
Successful observation blinds vary from the stuffed ox used by bird photographer Richard Kearton to tufts of cattails. Umbrella blinds consisting of a large umbrella frame and side curtains, are easy to set up

BIRD PHOTOGRAPHY: PART II

as are also the modern children's play tents. The latter are quite inexpensive and have the advantage of a screened ventilator window. They are water repellant and can be obtained in a deep green color. Observation slits can be cut in the sides and these in turn equipped with zippers. They are roomy—about seven feet square—and further camouflage can be accomplished by sewing loops on the outside through which grass or branches can be poked. Old burlap bags and even discarded awnings can always be used, but whatever the type of fabric, care should be taken to see that the fabric is stretched as tightly as possible to avoid flapping in the wind. A motion of this kind will alarm the birds.

In the setting up of a blind, the first setup should be made at a distance from the

nesting bird or the nest may be abandoned. As the bird becomes accustomed to the unusual contrivance near its home, the blind is moved up to the required range. After preparations are made, an assistant—if there is one—should leave the scene entirely. Birds are not able to count and will return to their nests in a few minutes, thinking the blind to be vacant. Otherwise the photographer may have a long wait and there is always the danger that the eggs may become chilled or the life within them destroyed by direct sunshine. In the blind setting process the light source should be studied especially for color photography. The ideal lighting condition may last for only a few minutes during the day and the photographer should be in his blind well in advance of the calculated time.



AIR BRAKES. This gannet has been caught in the act of stopping—perhaps for a landing. The photograph is interesting to the ornithologist because it shows the positions of wings, tail, and feet when "air brakes" are applied; it is interesting to the pictorialist because, caught in a sunset light, this bird makes a graceful, semi-silhouette composition. DATA: 35mm camera, 135mm lens, fast pan film, $\frac{1}{500}$ second, $f/6.3$
Photo, Albert Dixon Simmons

Recently I had the unusual experience of photographing the blue geese at their winter home along the coastal plains of the Gulf of Mexico. Every morning at daylight, thousands of these geese congregated for the grit end of their diet on what is known as the "goose bank" on Vermillion Bay, Louisiana. The problem was to guess just where they would land each morning, and in this case the fifth guess was the right one. Geese, away from their nests are among the wariest of our birds and a special blind was built at the beach hours before daylight. First a

pit was dug at the edge of the grass that fringed the beach. It was 3 feet square and 4 feet deep. At each corner small stakes were driven and burlap tacked around to a height of 2 feet. After I had crawled in, the warden sealed the top with more burlap and piled dead grass against the sides and over the top. The effect was that of the muskrat houses that were plentiful in the marsh behind the blind. In the setting up of this blind before daylight, I used a compass in order to establish the correct light source on the beach before me and to have an observation hole facing it. Holes were also cut for an eastern view to catch the sunrise, and a western view up the beach. The purpose of the west view was to catch the geese as they came in, for the wind was from east to west and the geese, if they came, would land against it. All this may sound like an elaborate set of precautions, but when I found myself later in the middle of a flock of about 15,000 geese, every calculation worked to my advantage.

In the matter of clothing for the bird photographer, I firmly believe in wearing the colors that blend with the surroundings. Discarded white shirts can be toned to greens and browns with a few cents worth of dye from the corner drugstore. But color alone should never be relied upon to do what freezing and stealth can accomplish.

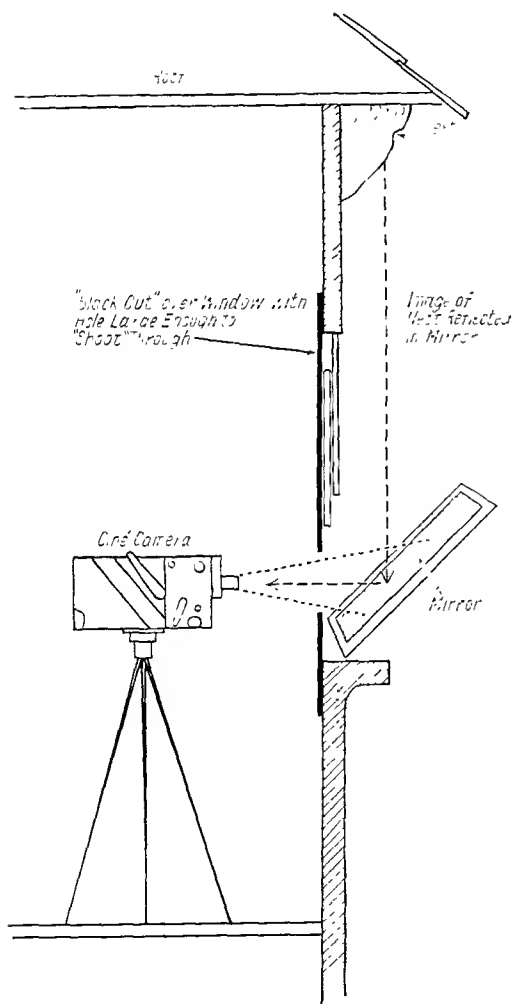
MINIATURE CAMERA

The many advantages of the 35mm precision camera in bird photography are:

Compactness for portability, and with it, lightness for carrying on long hikes where every ounce becomes a pound at the end of the day.

Economy of Film reduces the cost per negative when using the standard 12-, 16-, or 36-exposure rolls, and a further saving may be made by the purchase of 35mm film in bulk and loading it into the miniature cartridges. Since the film is also compact and light, an overabundance of ammunition is always on hand—not back on the trail.

Wide Range of Film Emulsions is available because of the developments in 35mm film for the motion picture industry—films of all types and for all effects including color.



HOW TO SHOOT THE HOUSE MARTIN. The natural nervousness of this migrant, together with the inaccessibility of its nest makes an arrangement such as this necessary. The accompanying photograph was taken, as shown, from inside the house—through a mirror. In this way, motion pictures can make a continuous record of this bird's movements

BIRD PHOTOGRAPHY: PART II

Fast Lenses make it possible to obtain successful pictures under poor lighting conditions, and when good light exists, faster shutter speeds may be used to arrest the tricky actions in bird life.

Greater Depth of Field (where far and near objects are sharp in one picture) is obtained with the comparatively shorter focal length of the miniature camera lenses than with similar speed lenses on larger cameras. Thus the chances of catching the bird in focus are increased.

Interchangeable Lenses permit the use of telephoto lenses so necessary in bird photography.

Built-in Range Finders (with lens and range finder synchronized) enable the bird photographer to check distances accurately, at the same time viewing the bird *directly*. This is a time-saving device that gets the camera into action with the least delay.

Accessories include among other things, extension tubes for extreme close-up studies of mere fragments of nature. The tubes are usually made of an aluminum alloy and add little to the pack. These, and other accessories, make the miniature camera cover almost every phase of photography.

Definition. The inability of the film emulsion to record the details thrown on it by precision built lenses was the gap that existed a few years ago, and it might well have caused the downfall of the miniature camera. Enlargements too grainy to look upon were the usual results. The problem was solved by the development of new sensitizing dyes. These dyes make the silver salts so responsive to light that large crystals—the grain producers—were no longer necessary. Small crystals could be used. Small films—those necessary for the 35mm cameras—became practical. The results



THE HOUSE MARTIN. The accompanying diagram shows how this picture of the shy house martin was taken

now obtained with the miniature camera in the field of bird photography are equal in every way to the work of larger cameras.

BIRD STUDIES IN ULTRA SLOW-MOTION

Arrested action pictures of birds on the move show merely the position at the time of exposure. In order to interpret such stills to their fullest extent, it is necessary to know what went on before and after the picture was taken. As an aid to the study of the fast bird movements that the human eye cannot follow, the slow-motion camera has been brought into use. It not only shows the behavior of birds from an educational standpoint, but it has brought to the screen a new poetry of motion.

The standard motion picture camera is designed to take as high as 64 frames per second, producing motion on the screen *four* times slower than normal. But many of the movements of birds, especially bird flight, are too fast for this speed. Thus the ultra slow-motion camera taking 128 frames per second—slowing down the motion *eight* times—is used. The screen results produced with this camera are nothing short of amazing and very little work has been done with it by the serious ornithological students. With the super speed camera, each frame is exposed at $\frac{1}{240}$ second and fast lenses as well as good light are necessary when working in color. A lens aperture of $f/3.5$ will get excellent results with Kodachrome under good light. Telephoto lenses of from 3 to 6 inches are necessary in order to get large screen images of the birds with the 16mm camera.

It is well known that in recording motion in color at the regular speed of 16 frames per second and a shutter speed of $\frac{1}{30}$ second there is a certain amount of blended color around the object in motion because of the fact that $\frac{1}{30}$ second does not stop the motion. In black and white the blending is not noticeable, but in color, the overlapping of colors actually has the effect of destroying some of the color definition. For this reason the color definition obtained with the ultra slow motion camera is unusually clear and sharp. Here are some of the things lost at regular motion picture speed—16 frames per second—that the super speed camera translates to

high entertainment and educational values: flycatchers gathering their insect prey on the wing, how a chimney swift drops into a chimney, the take-off and landing technique of waterfowl, and flight studies of our many birds.

SUGGESTIONS FOR THE STUDENT BIRD PHOTOGRAPHER

The more the student knows about the bird subject to be photographed, the easier the problem becomes and fortunately, our present day bird library is an excellent one. In it the student can become acquainted with the habits, nesting sites, and field markings of the birds. With this knowledge the photographic approach is simplified.

In the same way the mechanics of the camera should be studied—its limitations and the characteristics of the film placed within it. Know the camera and know the birds. Good pictures will follow.

BLACK EDGES. It is sometimes desirable to have black edges around an enlargement or contact print. In enlargements black edges are most desirable on high key prints or prints which incline toward grayness. The edge keeps the eye inside the picture. Black edges are also useful when the composition seems to call for "closing in" or support. A picture of a girl in a swing, for instance, should have some mental support and a black edge will do the trick if a tree or bar is not shown.

There are several ways of attaining black edges. Some workers prefer to work with India ink on a dry print, but this is often messy and requires the sure hand of a draftsman. Others get the effect by mounting the photograph first on a submount of black and then onto white. Both of these methods, while effective, are not *photographic* methods. The best method is a photographic one. For black edges on an enlargement, cut a piece of opaque paper slightly smaller than the enlargement sheet. After the print is made, remove the negative from the enlarger, place the opaque paper over the enlargement, and expose the paper for 2 or 3 seconds. When the sheet is developed out, the edges will be black and the entire sheet can be mounted on the background.

BLEACHING

In contact prints the same effect is achieved by trimming the negative so that it is slightly smaller than the sensitive paper.

BLACKING. To prevent undue reflection of light inside of cameras, enlargers, and other photographic instruments where absolute darkness is essential, many surfaces are treated by the manufacturer with what is known as blacking. This blacking will be found on the inside surfaces of most cameras—even on the moving parts. Lens mounts, film slides, and bellows must all be blackened to reduce the damaging power of extraneous light. When buying equipment, therefore, special care must be taken to examine the quality, permanency, and extent of the blacking. A lens shade, for instance, must always be black inside—and the same is true of other parts near the passage of light.

It is possible to apply blacking at home, if necessary. Chipping, rust, or wear might make a new coat necessary. Or, if a home-made device such as a cardboard extension tube or wooden sensitized paper holder has been made, blacking should be applied. In all cases, be sure that the surfaces are clean before application. Rust, which is apt to appear in enlarger heads or other areas where there has been excessive heat, should be especially guarded against.

There are many formulas and many methods for blacking. Aluminum and brass, for instance, will not accept the same blacking solution and they, in turn, differ from the blacking necessary for leather or wood. In general, the idea is to have a permanent coating or a matte surface—no reflections. Black paint, for this reason, is hard to use, as it so often has a glossy sheen. A good general blacking substance, though, is, according to Wall's *Dictionary of Photography*, a paste of lamp black and gold size. For wood a good black coating is ferrous sulfate followed, when dry, by tannin solution.

Wall, in his *Dictionary*, also gives this procedure for blackening aluminum: Clean the surface with emery or other fine abrasive, coat with olive oil, heat over a spirit lamp until black. Another good all-around blacking is a mixture of vegetable black with turpentine.

Caution should be exercised at all times, however. In applying blacking—especially to interior surfaces of enlargers, lenses, and cameras the photographer is taking a risk.

BLEACHING. The bleaching of negatives and prints, which means blanching the image until it is barely visible, is a part of several different photographic processes.

It is used in the reversal process to make positive images of negatives. It is employed as an intermediary step in the intensification of both negatives and prints. It is used to remove stains on negatives. And it is used on bromide prints before toning and before bromoil inking.

A number of bleachers are employed in these various processes. They are mercuric chloride, lead nitrate, potassium ferricyanide, potassium dichromate, etc.

In the reversal process, the metallic silver forming the image is bleached away by an agent that does not attack the undeveloped bromide of silver remaining in the emulsion. This is done after the negative has been developed, but not fixed. When the remaining silver bromide is given a general exposure to white light, it develops into a positive image.

The following formula for permanganate bleach is used in this process:

PERMANGANATE BLEACH

- | | | |
|----------------------------------|-----------|---------|
| A. Water to make . . . | 20 oz. | 1000 cc |
| Potassium permanganate . . . | 35 grains | 4 grams |
| B. Water to make . . . | 20 oz. | 1000 cc |
| Sulfuric acid (66° Be.). | 3½ oz. | 20 cc |

It is best to keep the two solutions separate until the time of use. *Always pour sulfuric acid very slowly into water and never reverse this or an explosion will occur*, which would also happen if the concentrated sulfuric acid were poured onto the permanganate.

For other formulas and details of the reversal process see the article on *Reversal*.

In the intensification of negatives, the first step is one of bleaching. The commonest form of intensification consists of bleaching the silver image in mercuric chloride and then blackening it with some one of many

reagents, to give varying degrees of intensification. The bleach for this process is as follows:

BLEACH FOR MERCURY INTENSIFICATION

Potassium bromide. . .	$\frac{3}{4}$ oz.	22.5 grams
Mercuric chloride. . .	$\frac{1}{4}$ oz.	22.5 grams
Water to make. . .	32 oz.	1000 cc

The negative is bleached in this until the image, as seen from the back, is completely whitened; then it is washed thoroughly. For other formulas and information on the intensification process, see the article on *Intensification and Intensifiers*.

Bromide prints as well as negatives can be intensified by first bleaching them in the following solution:

A. Potassium bromide. . .	1 oz.	50 grams
Water to make. . .	20 oz.	1000 cc
B. Water to make. . .	20 oz.	1000 cc
Hydrochloric acid . . .	2 oz.	100 cc

Hydrochloric acid should be poured very slowly into the water, as an explosion will occur if the water is poured into the acid. The same applies to sulfuric and nitric acids.

The print or negative is bleached in a mixture of A and B, the proportions depending on the amount of intensification desired. Intensification is greatest when the amount of B is so small that bleaching is very slow. It decreases as more B is used. For use, A is diluted with 6 times its volume of water, and an amount of B varying from $\frac{1}{4}$ to $\frac{1}{2}$ times the amount of A is added.

Another use for bleachers is in removing stains on negatives and prints. Yellowish stains on negatives, caused by use of an old or discolored developer, too warm a developer, or lack of agitation, can be removed by bleaching and redeveloping. Yellowish brown stains caused by iron rust or decayed vegetable matter in the wash water can be removed by bleaching and redevelopment. Dye stains on negatives are also removable by bleaching and redeveloping. For removing these stains, the following procedure is used:

First, bathe the film for 2 or 3 minutes in:

FORMALIN HARDENER (Eastman SH-1)

Formalin, 37% formaldehyde solution. . .	2½ drams	10 cc
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Sodium carbonate. . .	73 grains	5 grams
Water to make.	32 oz.	1000 cc

Wash for 5 minutes and then bleach in:

STAIN REMOVER (Eastman S-6)

Stock Solution A

Potassium permanganate. . . .	75 grains	5.3 grams
Water to make.	32 oz.	1000 cc

Stock Solution B

Sodium chloride (table salt)	2½ oz.	75 grams
Water to make.	32 oz.	1000 cc
Sulfuric acid, C. P. (concentrated)	½ oz.	16 cc

Keep the two solutions separate until time for use, then mix them in equal parts. Be sure that the potassium permanganate is thoroughly dissolved, as any particles of it out of solution will cause blemishes on the negative.

Bleach for 3 or 4 minutes and then remove the brown stain by first rinsing the bleached film in water and placing it in a 1 per cent solution of sodium bisulphite. Wash for 3 or 4 minutes and then expose to a strong light until the white image turns purple. Redevelop in a non-staining developer such as Nepera solution 1 to 2, or amidol without the use of bromide.

Another use for the bleaching process is as an intermediary step in the toning of prints. After the print has been completely developed and is completely free of hypo, it is placed in the bleacher and left until the last trace of black has disappeared from the deepest shadows. Then it is rinsed for 2 or 3 minutes before it is redeveloped. The formulas of bleacher are different for the various toners used.

BLEACH-OUT PROCESS. The bleach-out process is a method of producing line drawings from photographs. The process has widespread use in the making of commercial illustrations for catalogs and in illustrating periodicals.

The drawing is done upon the surface of a photographic print. Then the silver image of the print is washed away, leaving the line drawing. Prints on matte-surface paper are usually preferred by those who use this process regularly. If the drawing is to be done



PALE AND BLEACHED. The photo at the left is the pale print and an artist has begun to mark over the important lines with ink. On the right, the bleaching-out process is complete and a finished drawing of great accuracy is the result

Photo and drawing, David Charles

in pencil, a paper having the "tooth" of matte or rough surface is preferable.

To prepare a print for drawing by the bleach-out process, expose it enough to show the fainter detail without "forced" development. Then dilute the developer with several times its normal bulk of water and allow the print to stand in it only long enough to make those highlight details visible. At this stage the image will be pale and slightly greenish in tint. The work of drawing can be plainly seen as it proceeds.

The print is rinsed and fixed as usual. Washing is limited to 10 or 15 minutes, in order to avoid the accumulation of scum which sometimes forms in extended washing in hard water districts. When the print is hung up to dry, the surface water should be wiped off with a clean rag or sponge. This is to free the surface of any accumulations which might make drawing difficult.

Ink drawing done on the dry print must be done with "fixed" India ink, because of the subsequent wetting. Almost any kind of pencil may be used to produce sketchy effects. When the work is finished, the image is removed by any kind of reducer or bleacher. An alternative method is to soak the print in a solution of iodine in potassium iodide, and then in a plain hypo bath.

Care must be taken not to touch the drawing while it is wet. After a short rinse it is hung up to dry again, with all evidences of the photographic process obscured and the pen or pencil drawing remaining.

BLISTERS. Blisters, which may appear on both negatives and prints, are small crater-like pockets caused by the gelatin separating from the emulsion or the paper. Carbon dioxide gas, which forms blisters, evolves during processing when the sodium carbonate of the developer is neutralized by the acid in the fixing bath.

In the case of negatives, blisters are caused by:

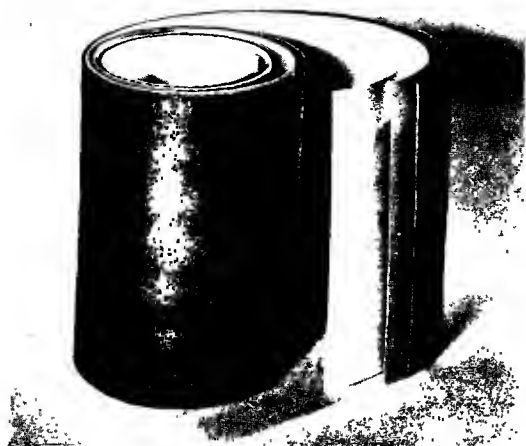
1. Highly concentrated developing or fixing baths
2. Overly warm developing or fixing baths
3. Insufficient washing of negatives after development

Blisters are more likely to occur in extremely warm weather when the film is not sufficiently hardened.

To prevent blisters, use processing solutions at their normal concentrations and normal temperatures. Wash the negative in clear water between developing and fixing. In hot weather, use an acid hardener before fixing the negative. Or put borate, phos-

phate, or any other substance which does not form carbon dioxide, into the developer in place of the usual carbonate.

In the case of prints, blisters can be prevented in the same way—by developing and fixing in solutions of normal strength and normal temperature. Extreme variations in the temperature of the several solutions should be avoided. When blisters occur in prints they can be reduced by placing the prints in a methylated spirit bath after they have been washed. (See article on *Frilling*.)



BLOTTER ROLL. The least expensive of the blotter drying methods is this simple roll. Prints are inserted between the white blotter layers and are held firm by the outside corrugated—which may be bound with elastics or clips

BLOCKING OUT. The term refers to the process of painting over certain parts of a negative with opaque pigment so that light cannot pass through it when printing. Thus the parts blocked out on the negative will appear white in the print. The process is used in eliminating distracting backgrounds, particularly when prints are to be used for commercial purposes.

The blocking out technic requires delicate handling of draftsman's pen and paint brush. The pigment for this work is supplied commercially, though thick water-color paint such as Indian red or lamp black can sometimes be used.

It is best to place the negative on a retouching desk. While the light comes through the negative, the opaque is applied on the film side. If the subject contains a

number of straight lines it is best to rule these first with a draftsman's ruling pen. For the curved lines, draftsman's curves may be used or a freehand method. When the outline is well marked, the line is broadened with a paint brush as extensively as is desired. A small brush is used on small areas, a large brush on larger areas. Some workers use a small pen knife to outline the edges of the image, then follow the faint knife line with the paint brush.

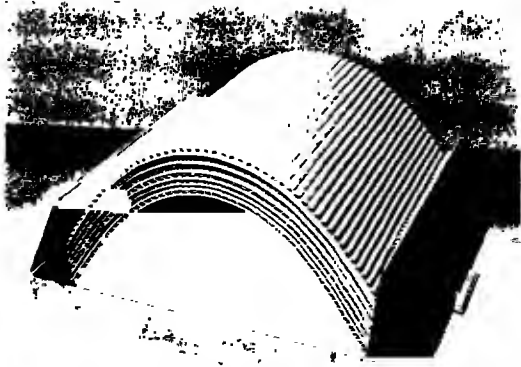
Before any work is undertaken, negatives should be clean and free of finger marks. If such marks are present, they should be removed with a tuft of cotton wet with benzine or carbon tetrachloride.

BLOTTER BOOK AND ROLL. Bound blotter books of highly absorbent sheets are available for drying prints. Each sheet of blotter is faced with a sheet of waxed paper to protect the print from lint, etc. In these books prints dry clean, flat, and rapidly.

One type of print dryer is the blotter roll, consisting of two long rolls of white blotting paper. One of the rolls has a linen lining against which the emulsion side of the print is placed. A strip of corrugated board around the two rolls helps to keep the air circulating.

The Kodak Blotter Roll is 11½ inches by 6 feet and has a capacity of about 60 prints.

Drying, the last part of the printing process, should be done carefully—as a print can be made or ruined at this point. (See article on *Drying Negatives and Prints*.)



LAW PHOTOPRINT DRYER. This blotter dryer is designed to allow a circulation of air. It has a capacity for 12 prints of 8 x 10 or 96 prints of 2½ x 3½. As all prints have a tendency to curl toward the emulsion, they should be placed in the blotter emulsion side up

BLUEPRINTS AND HOW TO MAKE THEM

Vernon D. Tate

Director of Photography, National Archives, Washington, D. C., Editor, The Journal of Documentary Reproduction

A not-too-technical description of all the blueprinting or cyanotype processes—sepia, ferro-gallic, true-to-scale, and positive. This article covers them all, tells how professionals work and how the amateur, too, can use blueprinting to copy line drawings, photographs, printed pages.

See Also Copying, Diazotype

THE MOST common photographic printing process using organic iron salts is generally known in the United States as blueprinting. Other less common synonyms are: cyanotypes, ferropussiate prints, iron prints, and the like. Blueprinting is probably the oldest photographic process in widespread use today. It was discovered in 1842 by Sir John Herschel, and with relatively few changes has continued to the present time. Wall in his *Dictionary of Photography*, under the heading "cyanotype," describes the process as follows: "The reduction of a ferric salt by light to the ferrous state, and the precipitation of Prussian blue by the action of potassium ferricyanide." The practice of blueprinting, however, has become so well identified with a special application in the reproduction of engineering drawings and builders' plans that the layman and frequently even the photographer have ceased to regard it as a photographic process.

BLUEPRINTING

Blueprints are made by contact, washed in water, and, as usually printed, show a negative image of white lines on a background ranging from deep blue to a light grayish blue. When printed from a negative, the image appears in blue on a white background. The process is ideal for the reproduction of line originals and, although the tonal scale is rather short, it may be used to advantage for special effects with full tone negatives. One modification, the *platinotype*, using platinum and recently the cheaper palladium salts, is generally considered to

be the finest printing medium available to the photographer.

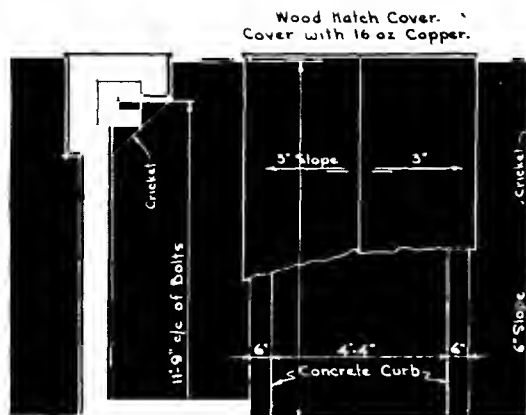
Advantages of the blueprint process include its cheapness and the ease with which the paper may be prepared and developed. Disadvantages are its slowness, the strong light required for printing, and the relatively short life of the sensitized paper. Blueprints may be intensified, reduced, or toned to a color approaching black.

OTHER IRON PROCESSES

Of the many iron processes allied to or deviating slightly from blueprinting, the most important in terms of use are the vandyke or sepia, the ferrogallie, and the true-to-scale processes. The *vandyke process* is used for the making of reversed or mirror-reading negatives from which blue line prints (blue lines on a white background) on regular blueprint paper are produced. The negative is brownish black, and it is possible to make sepia prints by printing on vandyke paper.

Ferrogallie or gallic prints are now obsolete and little used in the United States. Unlike the blueprint or the vandyke, where the basic color is imparted by a reaction in the background and only the opaque lines which prevent exposure remain white, exposure on a ferrogallie paper causes the background to become soluble leaving the image in bluish black lines on a white background. The process is much more complicated and less certain of success than the ordinary blueprint, and is more than twice as expensive. Its principal advantage is in printing soiled or damaged tracings or in making partial copies, as undesirable marks may be removed with a pad of cotton during development.

The *true-to-scale process*, while based on blueprinting, is actually more closely allied to lithography. Its principal advantage, apart from the accuracy of the scale, is in the number of excellent cheap copies which can be prepared from a given original. In outline the process consists of etching a prepared gelatin plate by contact with an exposed but undeveloped blueprint and inking the gelatin with printer's ink. Up to 25 permanent copies may be pulled from the plate. As no water is employed in the proc-



ARCHITECT'S DRAWING. This was made from a tracing and shows the familiar form in which most of us see blueprints

ess, there is no paper shrinkage and the copies are substantially true to scale. While the method is useful for the reproduction of maps and accurate scaled drawings, it has been largely superseded by recent advances in offset lithography and diazonium printing.

USES OF BLUEPRINTS

Blueprinting is used for a great variety of purposes of which, as has been indicated, the most important is the reproduction of engineering drawings, plans, and sketches. Any line original, if suitably prepared, may be printed on blueprint paper. Maps, plats, charts, statistical graphs, and similar originals are frequently duplicated by this process. Specifications and typewritten matter, if typed with an opaque ribbon on translucent paper, are easily reproduced. Menus, theses, and small frequently revised instruction books containing drawings are examples of work of this type. Photolithographers frequently proof large negatives on blueprint paper and sometimes sensitize plates with blueprint emulsions and print in guide marks for making up complicated layouts. The photographer, in addition to these uses, may find blueprinting an ideal medium for special effects. Snow, ice, or water scenes, in fact any subject which

might be toned with a blue toner may be printed on blueprint paper at little cost and often with strikingly beautiful results. Files of negatives may be printed on blueprint paper for cataloging at a fraction of the cost of regular silver paper. The process may be used for printing pictures on cotton or linen cloth and on other substances. Through the use of toners and variations in the process the basic color may be altered as desired within certain limits. The process can be used also to imprint the details of leaves, flowers, etc. on the sensitive paper and, in this way, photographs of interesting patterns can be made.

EQUIPMENT AND TECHNIC

Blueprint emulsions coated on paper or cloth are readily available in blueprint, art, and in some cases photographic supply houses. The materials are classified by speed, which is generally measured by printing time required in sunlight (a normal speed paper requires 3 to 4 minutes printing time in bright sunlight), and by the composition and thickness of the paper. Thicknesses are usually designated by extra thin, thin, medium, and thick; and quality by the rag content, which may be 25, 50, or 100 per cent. Packaging is in rolls of from 24 to 54 inches wide in standard lengths of 10, 50, and 100 yards. The shorter rolls are usually slightly more expensive than longer lengths. It is also possible to purchase unsensitized paper or cloth, sizing, sensitizing, and transparentizing solutions—although the quantities are usually suited only for professional use.

In general the faster grades of paper are used for the production of blueprints in quantity while the medium and slow grades are used for the production of blue line prints. Only the slower grades of paper are suitable for printing from photographic negatives. The slower papers yield the deeper blue.

Blueprinting equipment ranges from a simple printing frame and sunlight to large continuous machines of great capacity. The printing frame is satisfactory for amateur use, and a good photographic printing frame of suitable size is ideal. Large sheets may be printed in an emergency by placing in the

SENSITIZING

sun on a pad, as for example a folded blanket, and covering the tracing and sensitive paper with a sheet of plate glass. The tracing or negative is placed right side up against the glass and a sheet of blueprint paper, emulsion side up, is brought in contact with the negative. The felt backing pad is placed in contact with the paper and the back of the frame is put in place. The frame is placed in sunlight for a length of time commensurate with the speed of the paper being used, and exposed. Normally the paper is yellow in color, and it should be printed until the background or exposed areas are uniformly gray with the lines appearing greenish yellow. This may be ascertained by turning back a portion of the paper in the frame, taking care not to alter the registration of the tracing and the paper, or some waste slips of sensitive paper may be inserted around the edges of the tracing (so placed that the light must pass through the tracing before falling on them) and removed for test development. When exposure is complete, the print is removed and developed by washing in plain running water, or—if trays are used—in several changes of water. For best results the contact must be good, no wrinkles may appear in the paper, the printing glass must be clean, and the frame must be placed in a position where it will be evenly illuminated.

Blueprints may also be printed with ordinary incandescent or photoflood light although much more time will be required. Mercury vapor illumination or arc lamps may also be used and the results will be much better.

Professional blueprinting equipment is available in various sizes and capacities. The smaller machines usually consist of a cylinder or half cylinder of glass mounted vertically. Light is supplied by an arc or mercury vapor lamp placed in the center of the glass cylinder, and the tracing or negative is held in contact by a curtain. Where greater capacity is required, the machines are usually horizontal, and contain several arc or mercury vapor lamps for increased speed. The largest machines have developing and drying equipment directly connected to the printer, and produce finished work at speeds in excess of 15 feet per minute.

One of the important advantages for the amateur in the blueprint process is the ease with which paper may be sensitized. A good grade of bond paper, or smooth hard-surfaced drawing paper, may be sensitized for blueprinting photographic negatives as follows:

Prepare two solutions:

Solution A

Potassium ferricyanide.....	40 grams
Water.	250 cc

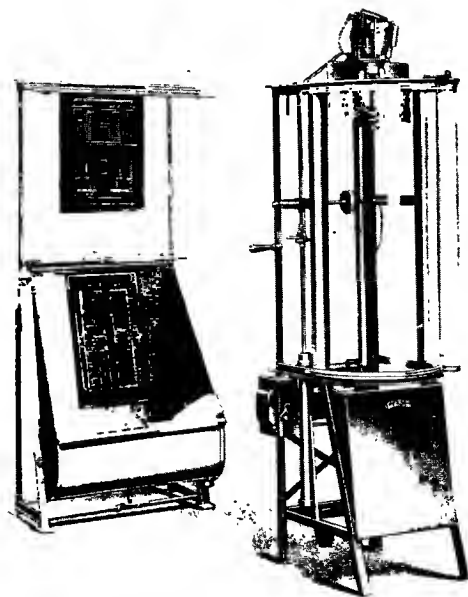
Solution B

Green ferric ammonium citrate..	95 grams
Water.	250 cc

Note: Use distilled water for best results.

The potassium ferricyanide crystals are sometimes contaminated by yellow ferric salts and therefore should be rinsed in distilled water and dried on blotters or filter paper before weighing.

Store these stock solutions in brown bottles which are tightly corked. In a photographic darkroom illuminated by yellow or orange light mix equal parts of Solutions A and B, filter, place in a tray, and float the paper on



VERTICAL BLUEPRINTER AND WASHER. Many offices, where much blueprinting is done, have small blueprinters to do the work. Here is one shown with a print washer

C. F. Pease Co., Chicago

the surface of the sensitizing solution for approximately 1 minute, then hang up in the darkroom to dry. Drying should be rapid and if the relative humidity of the drying space is high, some heat must be used. It is also possible to coat the paper by tabbing it to the back of a large tray or sheet of glass with scotch tape and applying the solution with a pad of cotton, taking care to spread an even coating over the entire surface. This may be achieved by working rapidly from top to bottom and then from side to side. A wide, very soft brush may be used. This latter method of coating is particularly useful for larger sizes of paper that would be inconvenient to float. The resulting paper will be relatively slow, but will give good blue color and a suitable range of tones.

Another formula yielding slightly more contrast than the former, and hence more suitable for line work, is as follows:

Solution A

Potassium ferricyanide.40 grams
Water.250 cc

Solution B

Brown ferric ammonium citrate 110 grams
Water.500 cc

Mix and apply as above.

Numerous additional formulas will be found in the references appearing at the end of this article. As the sensitizer compounded from Solutions A and B deteriorates rapidly, it is advisable to discard it after using once. The solutions when separated may be kept for several months.

The sensitized paper should be used as soon as possible after coating, and should be developed immediately after exposure. If stored in the dark in a cool dry place, the sensitized paper will keep from two to three months.

POSITIVE BLUEPRINTS

A positive blueprint or cyanotype, gives blue lines on a white ground. In this process the paper is coated with a mixture of the three solutions given below:

1. Gum Arabic.20 parts
Water.100 parts
2. Ammonio-citrate of iron . . .50 parts
Water.100 parts
3. Ferric chloride.50 parts
Water.100 parts

These solutions are mixed in the order and proportions given below:

Solution 1.20 parts
Solution 2.8 parts
Solution 3.5 parts

While being mixed the solution changes from a thin state to a thick state and finally returns to a clear liquid.

The paper used must be sized. Then the solution is applied with a broad brush. The paper is dried in a warm room, protected from damp and light. In printing the image appears as yellow on a darker ground. After the exposure has been made the paper is treated with a developer, also applied with a broad brush. The following developer may be used:

Potassium ferricyanide.20 parts
Water.100 parts

As soon as the image appears the print should be rinsed in water, immersed in a bath of dilute hydrochloric acid—one part to ten parts water (and be sure to put the acid into the water, *not vice versa*). When the ground appears white, the prints should be removed, washed, and dried.

TREATMENTS AFTER EXPOSURE

After development is complete, small blue-prints may be dried between blotters, or the surplus water may be removed by means of a squeegee or wringer and the print run through a dryer. A wrinkled print may be flattened by placing it over a pad and ironing it on the back with low heat. Too much heat will spoil the print.

Underexposed prints may be intensified in a one percent solution of sulfuric acid. After this treatment, wash the print thoroughly. The following formula has been suggested for reducing overexposed blueprints.

Ammonium bichromate.30 grams
Chrome alum.15 grams
Cold water to make.4.0 liters

The two chemicals should be mixed in boiling water and cold water added to make up to quantity. Use the solution cold in a tray or it may be swabbed over the surface of the print with a cotton pad. Wash the print thoroughly after using.

Faded blueprints may sometimes be restored by treatment with a very dilute

BLUEPRINTS AND HOW TO MAKE THEM

solution of hydrogen peroxide. If stored for a period of time in a cool damp place, faded blueprints sometimes regain their color. Many formulas and working methods have been proposed for the rescue of over- or underexposed blueprints. The cost of the paper is so low, however, that the best and cheapest remedy if conditions permit, is to make a correctly exposed print. Spots can be removed from the dry prints by touching them with a 4 per cent solution of potassium oxalate.

It is sometimes necessary to make corrections or write on blueprints in ink or pencil. Special aluminum pencils for this purpose are obtainable, or if they are not at hand, a yellow crayon or pencil is often used. A 20 per cent solution of neutral potassium oxalate thickened with gum arabic may be used in an ordinary writing pen, or the same colored with red aniline dye will produce a red line. If the writing is blotted immediately it will remain permanently. The blue background may be bleached with ammonia and white spots tinted with ordinary prussian blue water color.

BLUEPRINTING PENCILED AND TYPE-WRITTEN MATTER

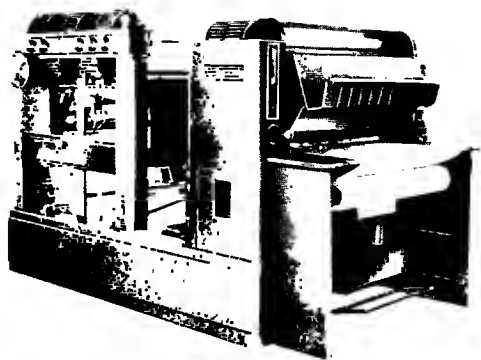
Drawings or sketches on medium-weight paper may be blueprinted with fair success if the paper is transparentized. Proprietary solutions for this purpose may be secured from dealers in photo-offset supplies, or any one of several methods may be followed. Ordinary kerosene will render the paper much more transparent until it evaporates. Castor oil, 1 ounce, and alcohol, 4 ounces, will also serve. In printing pencil lines, a shorter exposure should be used as the pencil lines are not as opaque as ink lines.

Typewritten matter, particularly if prepared for the purpose, will reproduce well in blueprint. To prepare a page for blueprinting, use a special matte surface tracing paper and a lithographic ribbon or a carbon paper ribbon and type with an even impression. Increased density may be secured by placing a new sheet of carbon paper *with the carbon back toward the paper* in the machine. This practice, known as carbon backing, produces an image on both sides of the sheet. If a positive blue line print is

required, a vandyke negative or a photographic negative on film or paper is used.

COPYING BLUEPRINTS

Excellent photographic copies of blueprints or blue line prints may be made using conventional equipment and a slow panchromatic process material with a red Wratten A or similar filter. If the blueprint has corrections or additions in red ink or pencil the same type of film with a green Wratten B or similar filter should be used.



CONTINUOUS BLUEPRINTER. This large machine shows the kind of equipment available for mass production blueprinting. Far removed from this is the old and simple method of blueprinting—by using a contact frame and exposing to the sunlight
C. F. Pease Co., Chicago

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Much valuable information will also be found in *The International Blueprinter* (1928 to date).

BLURRING. Images having indistinct or double-outlined edges are said to be blurred.

Blurring can occur either in making the negative, making the contact print, or in the enlarging process.

Blurred negatives result from:

1. Movement of the camera during the instant of exposure
2. Movement of the subject during the instant of exposure
3. The use of an imperfectly corrected lens
4. Condensation of moisture on the lens
5. Incorrect focusing
6. Underexposure and underdevelopment

Probably the most common cause of blurred negatives is movement of the camera during the instant of exposure. Theoretically there is no such thing as holding a camera absolutely still, even at shutter speeds of $\frac{1}{100}$ second or higher. Miniature cameras are more difficult to hold steady than larger cameras. It is rarely possible to secure a clear image for enlargement at any shutter speed less than $\frac{1}{25}$ th of a second without a tripod.

Camera motion is sometimes caused by a jerky use of the shutter release. The photographer should think of his shutter release in the same way he does the trigger of a gun, and practice a smooth follow-through pressure on the release.

Failure to "freeze" the subject in action photography is a common cause of blurring. Beginners often overestimate the ability of their camera to stop action. Don't try to photograph an express train—or even a running child—with a camera whose fastest shutter speed is $\frac{1}{25}$ th of a second. The angle from which a picture is made is a big controlling factor in stopping motion. Objects moving at right angles across the field of vision appear to be moving at a much greater speed than objects moving toward or away from the camera. It is necessary to photograph high speed objects—like express trains, airplanes, racing cars, etc.—at an oblique angle. A three-quarter angle is the most effective for stopping action and avoiding blur in a negative.

Charts are available which give the exact shutter speeds for stopping different types of action (See *Action Photography* and *Bird Photography, Part II*).

Another device for stopping fast action with a comparatively slow shutter speed is that of panning. This technical trick is used by professional photographers of horse and auto races. They train their cameras on the subject while it is still some distance away. As it moves forward, they move their camera in an arc to follow it, keeping it always in the center of the view finder. When it reaches the desired spot, they release the shutter and get a sharp picture of the subject. The background in this type of shot will be blurred, but this is an effective way of suggesting the speed at which the subject is moving.

To correct blurring caused by poor lens quality, have the lens checked and adjusted properly. Condensation of moisture on lenses usually occurs when the camera is taken from a cold room into a warm room. Blurring from such causes can be prevented by giving proper attention to the care of the lens. Blurring caused by a defective lens cannot, of course, be corrected.

Blurring in prints is sometimes present even when a sharp negative is used. The causes for blurred contact prints are:

1. Imperfect contact between paper and negative
2. Placing the paper against the glass or celluloid back of the negative instead of against the emulsion

Blurring is even more likely to occur in enlargements. Causes for blurring in enlarged prints are:

1. Vibration of lamp house during exposure
 2. Enlarger lens out of focus
 3. Movement of table, baseboard, or paper holder during exposure
- These difficulties can be prevented easily by careful darkroom methods.

BOOKPLATES, PHOTOGRAPHIC.

What you prefer to put on your bookplate in the way of text is, of course, up to you. Some like the short: "Ex Libris—John Doe;" others like to include a poem or an appropriate quotation; then there is the humorous "Stolen From the Library of John Doe." The choice of a photographic subject is also largely personal: it may be a self portrait, a favorite pictorial shot, an illustration of

your hobby or of your favorite book. The main thing is to identify the book and to create an interesting piece of photographic work in the bargain.

The problem is to combine the lettering and the print. There are many ways of doing this:

1. Make a straight photograph and print your text matter on it by hand.

2. Do your printing on the negative itself—either with opaque paint or retouching substance, or with a cutting instrument, depending upon whether your bookplate requires black or white lettering.

3. Project the photograph onto enlarging paper, where the lettering is incorporated by masking—a version of the stencil process.

4. Photograph the subject matter and the lettering together, both mounted on a white card.

5. Incorporate the lettering in the photograph. For instance, picture a row of your favorite books with a card, bearing your name and the text matter, placed across them.

6. Combining two negatives: a negative showing your scene and one of the text matter can be bound together to make one negative for printing.

7. Use a paper negative. This is a rather more complicated but flexible method of making bookplates. With this, freehand drawings and signatures are easily possible.

In photographing the basic scene for your bookplate, even more complex technics can be used. Table top photography can give some amusing effects and combining the picture with lettering is easy here. Bas relief photography can give an etched impression, often good in a bookplate. (See articles on *Paper Negatives*, *Table Top*, and *Bas Relief*.)

The paper can be semi-matte or satin. Glossy is not recommended, as imperfections in lettering or in combining negatives are too obvious. The bookplates can be any size, but $3\frac{1}{4} \times 4\frac{1}{4}$ is average.

As for the methods of making copies—there are two:

1. Photomechanical reproduction. Half-tones can be made of your finished product and the local printer can reproduce the bookplate on gummed paper.

2. Contact printing or enlarging. In this, it is of course easier to work with one negative, and methods 1 and 3 of combining lettering and the scene are not recommended for more than a few copies. A good way to save time is to mark off a large sheet of sensitized paper and make 6 or 8 copies on one piece—being careful to mask the others while one is being exposed.

BOTANICAL PHOTOGRAPHY

Paul J. Sedgwick

Professor of Botany, Syracuse University

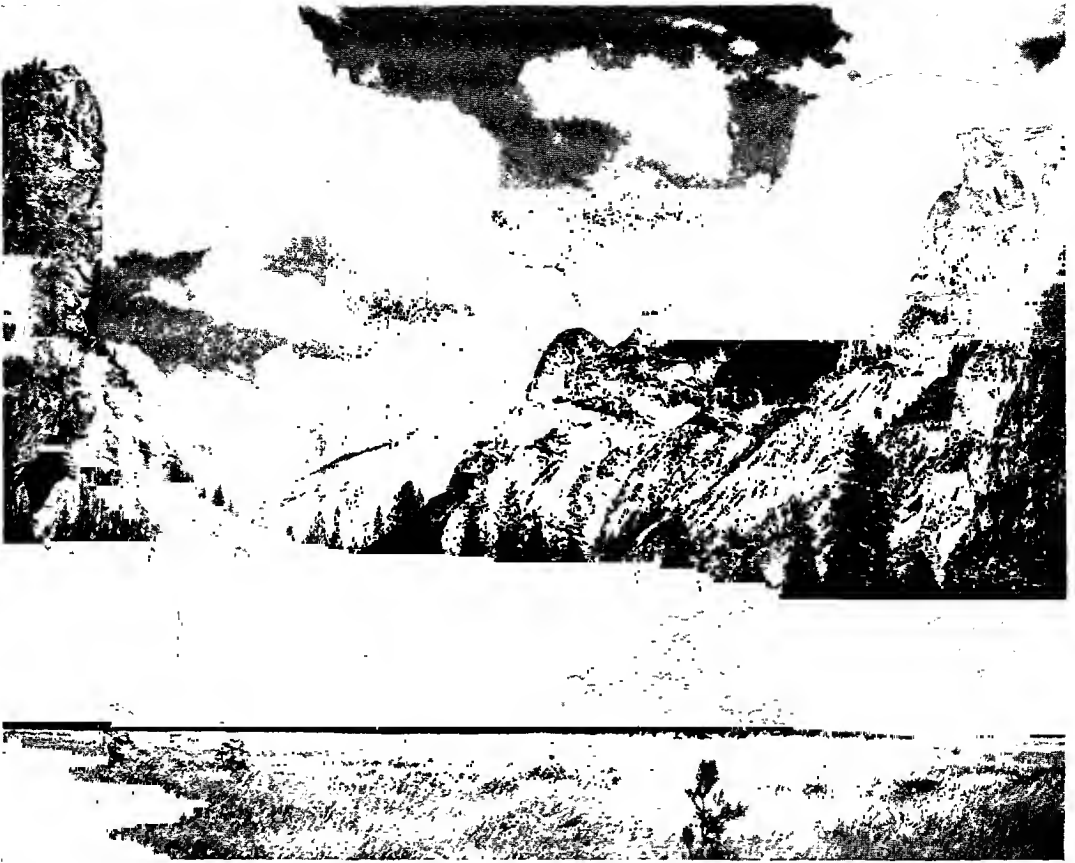
The photography of plants—in the field and in the laboratory or greenhouse—is described here. The article covers such necessary subjects as equipment, field observations, backgrounds, and color work. It should be useful to all who find the photography of plant life an interesting pastime as well as to those who use photos for scientific study.

All photographs by Paul J. Sedgwick.

See Also Biological Photography, Garden and Flower Photography, Tree Photography

BOTANICAL photography is as varied as the interests of the botanists, professional and amateur, who engage in it. For the plant *morphologist* and the plant *cytologist* it will mean photomicrography—the photography of thin sections of tissue and cells through the microscope at great magnification. For the plant *ecologist* it will mean the photography of plants in the field to show their grouping into societies, and their relationship to their environment. For the plant *physiologist* it will mean photographing the equipment for and the results of experiments performed with plants in the laboratory or greenhouse, perhaps including the time-lapse motion picture photography of the actual responses of the plants to the stimuli.

Taxonomists will photograph the plants that they collect so as to show their natural habitats and perhaps close-up photographs of parts of the plants to show minute details and characteristics. The *mycologist*, will make photographs of the mushrooms and the other types of fungi with which he is concerned. To the plant *pathologist* botanical photography will mean the field and laboratory photography of diseased plants to show the effects of the disease upon the whole



FIELD PHOTOGRAPH. This shot was made originally in color on professional Kodachrome 4 x 5 size. A black and white negative was made from this and, in turn, a black and white print. The photograph proves that botanists often have a chance to make beautiful pictorial pictures in the field

plant. The *geneticist* and the plant breeder will use photography to record the characteristics of the parental types which are brought into a cross, the progeny of the cross, and the descendents through several generations.

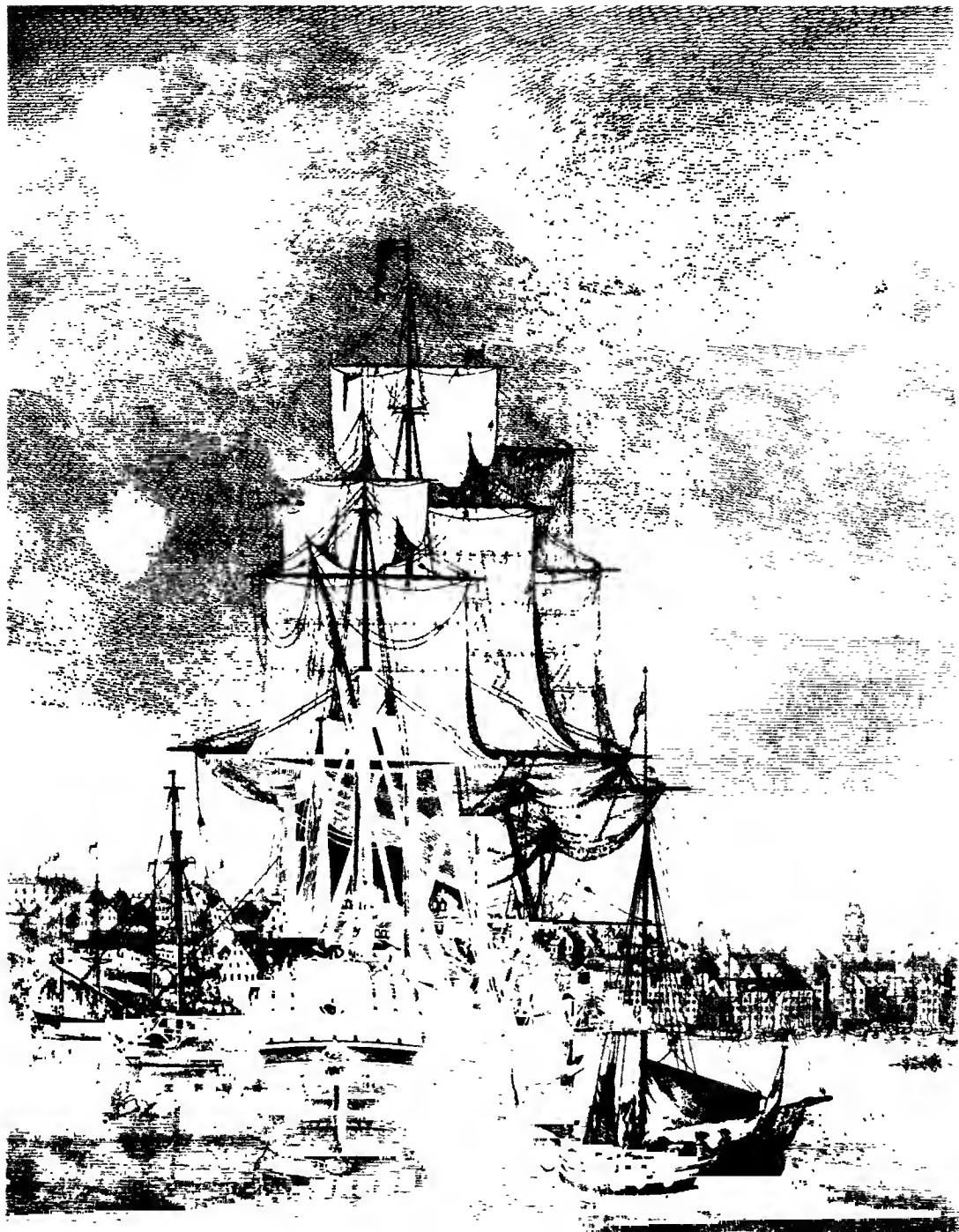
To the *forester* photography will mean, among other things, the picturing of trees to show their habit, and the close-up photography of twigs, buds, flowers, bark, and seedlings. The *garden lover* will make still or motion picture photographs of flowers in the garden, preferably close-ups in natural color to reveal all of the details of beauty. To the *teacher* of general botany, photography will mean all of these, and more too.

EQUIPMENT

The equipment for botanical photography will depend upon the type or types of work undertaken. The equipment may range

from an inexpensive hand camera to an elaborate apparatus for time-lapse photography or an expensive photomicrographic camera. It may be said that with reasonably good, accurate equipment, success in botanical photography, just as in other fields of photography, depends far more upon the skill and care of the photographer than it does upon the cost of the equipment that he is using. This is not said in order to discourage the botanical photographer from owning the best equipment he can afford. The best equipment will permit the careful worker to surmount many difficulties. But in the hands of the unskilled, careless worker, expensive equipment will be no guarantee of success.

The decision as to picture size will rest in part upon whether the worker wishes to obtain the full picture size in the original negative or whether he wishes to print by projec-

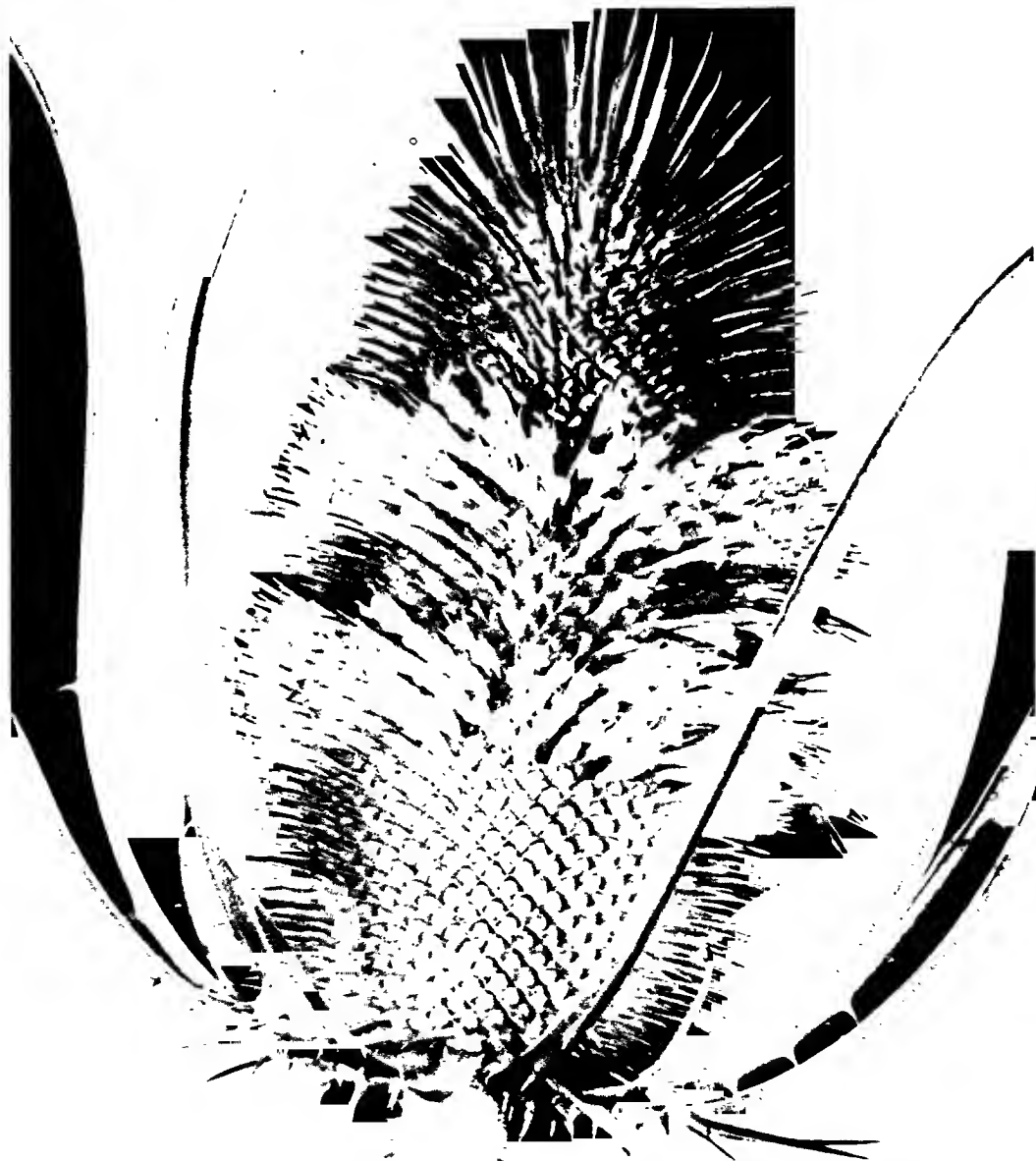


BLUEPRINT REPRODUCTION. Often associated with black and white line drawings such as architects' plans, blueprints can actually reproduce a variety of tones. This engraving was first photographed in black and white—and a blueprint was then made from the regular negative. Notice how the in-between tones have been kept.
See article on *Blueprints* by Vernon D. Tate on page 465
Blueprint, Vernon D. Tate

tion. It will depend in part, also, upon whether he wishes to use most of his pictures as lantern slide transparencies, on whether he wishes to make paper prints, and also upon whether he plans to work in color as well as in black and white. Some workers still use the 5 x 7 size exclusively, others use smaller sizes such as 4 x 5, 3½ x 4½, and 2½ x 3½, while still others do most or all of their work with one of the several precision built

miniature cameras. The size of the original negative is not as important today as it was in the past, thanks to fine grain emulsions of excellent characteristics and perfected methods of processing the films.

In general it may be said that the botanical photographer needs a sturdy camera, accurate in its adjustments. There must be provision for careful focusing. The lens should be a good anastigmat of ample focal



FLOWER HEAD OF THE TEASEL. This black and white enlargement came from a 35mm Kodachrome negative and it shows in great detail the teasel head once used to raise the nap on woolen cloth

length. The camera should have either a long bellows or have extension tubes (as have some of the miniature cameras) so that extreme close-ups can be made of small objects. There should be a lens hood to shield the lens from extraneous light. The botanical photographer will also need a steady tripod because so many of his exposures will have to be relatively long to obtain sufficient depth of field in the close-ups. He will also find compensating filters helpful in achieving the results he desires. A photoelectric exposure meter is useful.

RECORDING FIELD OBSERVATIONS

Many botanists engaged in field work find a camera as essential as the note book for recording their observations. The pictures which they make may be used later for publication in reporting the results of their research, or they may be used in classroom instruction. They may serve for lectures given before the general public, or they may simply remain in the field notes of the botanist to aid in keeping fresh the record of his observations. For the routine recording of field observations the precision miniature camera affords the opportunity of making



THE FRUIT OF A TULIP. Many times life size is this detailed photograph of a tulip, cut open to show the developing seeds



PHOTOMICROGRAPH. This cross section of the underground stem of *Osmunda*, one of the ferns, was taken through a microscope. Lighting from below gives a silhouette effect and shows cell structure clearly

many pictures at a very low cost, and it has the further advantage of being light in weight and of taking little space. The 5 x 7 camera is apt to be carried into the field only when some important need is foreseen, whereas the miniature camera will probably be carried at all times.

When making photographs to supplement the written notes it is very important that complete data be recorded for each photograph and that no fact essential to the identification of the picture be left to the memory. Each photograph should be assigned an identifying number at the time that it is made. If this number is also incorporated in the written field notes, there will be no difficulty later in associating the pictures with the notes.

A very useful adjunct to the equipment of the botanist-photographer who is engaged in field work is a changing bag. With this, in the absence of a darkroom, film holders can be loaded and unloaded, and the exposed film can be placed in light-tight tanks for development.

The botanical photographer will find in making extreme close-ups of flowers or other

parts of the plant that it is necessary to compensate in the exposure for the short distance from the lens to the subject. The necessary increase in exposure can be worked out each time by using the appropriate formulas but it is much more convenient and time saving to have all of this information for various distances worked out in advance. In making the close-up picture it is then only necessary to measure the distance to the subject, after which the factor for the increase in exposure can be read from the table or graph.

COLOR AND STEREO WORK

Many workers are finding the color transparencies in the miniature size not too expensive to use even in connection with their routine note making and certainly much more vivid as notes than the black and white pictures. Probably every one who has used the color pictures has been impressed by how much more can be recalled from a color photograph than from a black and white photograph. Color transparencies in the larger sizes can be used occasionally for important pictures where a definite need for a larger picture is seen. The use of Kodachrome film does not preclude the possibility of later having black and white paper prints or paper enlargements. It is an easy matter to make a black and white negative from the color picture, and from the negative, a black and white contact print or enlargement.

In some respects the stereoscopic camera is the ideal instrument for use in making photographic records and it is surprising that more botanists have not discovered the advantage of its use. When the stereoscopic pictures are made as color transparencies the ultimate in perfection is very nearly reached. Viewing a good stereoscopic color transparency is almost equal to seeing the flower itself. Every detail of the original scene reappears in beautiful perspective. A stereoscopic color picture is the most complete and perfect record picture that it is feasible to make. It could be surpassed only by making stereoscopic natural color motion pictures. Professional Kodachrome cut film is available in the 45 x 107mm size and in the 6 x 13cm size for use in stereoscopic cameras. Stereoscopic color pictures can also

be made with the Leica camera on the 35mm film by using the "stereoly" attachment which fits over the lens. Some workers have made them by using two miniature cameras mounted side by side on a common base, in which case, if the scene includes any objects in motion great care must be exercised in order that the two exposures be absolutely simultaneous.

BACKGROUNDS

In making close-up flower portraits there may be need in some instances for a background so that the lines of the flower will



EXTREME CLOSE-UP PHOTOGRAPHY. The fungus of an agar plant is being photographed in great detail. The regular sliding focusing attachment and extension tubes are in use—and also a spotlight in addition to the regular lighting equipment

not merge with the confusion of lines in the natural background. For this purpose, the field equipment should include pieces of velveteen or other suitable material in black and in gray. The background material may be carried without introducing wrinkles and creases by rolling it with the slender dowels which will be stuck into the ground later and used to support the cloth background. Pieces of cloth to serve as wind breaks can also be rolled with the dowels and carried in this way. In this connection it is interesting to note that in making natural color por-



PHOTOGRAPHING A FUNGUS CULTURE. A Leica is being used here with the regular sliding focusing attachment. After the image is focused on the groundglass, as shown in the illustration, the camera will be slid into position for the picture. Notice the extension tube on the lens

traits of flowers there is much less need for artificial backgrounds than there is when making black and white flower portraits. The differences of color in the object and in the background effectively separate the planes and prevent a confusion of lines. It may also be noted that in stereoscopic flower photography there is no need for a background when working in either black and white or in color. When the stereoscopic pair is viewed in the stereoscope the objects stand out without interference or confusion.

PRECAUTIONS

In preparation for extended field trips the botanist will give considerable thought to the protection of his equipment against dust, sand, etc., and of his supply of film against overheating and excessive moisture, both before exposure and after exposure. For work in the tropics the film should be obtained from the manufacturer in tropical packing, and the instructions of the manufacturer followed closely for handling after the exposures have been made. Attention should be given to the lens to see that it remains clean during the trip. Recently one manufacturer has found it necessary to call attention to the fact that the glove

compartment of a car may become excessively hot and that it is not a good place in which to carry camera and film. It may also be noted that when one is working under conditions of intense sunlight and great heat such as prevail in many parts of the west and southwest of our country during the summer, a light colored camera bag is better than a black one. The black bag will absorb so much heat from the rays of the sun that the contents of the bag may be raised to a very high temperature.

PHOTOGRAPHY IN THE BOTANICAL LABORATORY AND GREENHOUSE

The same photographic equipment which is of use in the field may also serve in the laboratory and greenhouse, and in addition there may be other equipment which would not be suitable for carrying into the field.

One of the most useful pieces of equipment in the laboratory is a copying stand or table built with adjustable lights and a support for the camera—arranged for conveniently doing copying and the close-up photography of small pieces of equipment, culture plates, parts of plants, and the like. Routine work which would be very time consuming if a separate set-up of camera, tripod, easel, and lights had to be made each time, can be handled quickly and easily with such a table.



COPYING TABLE. Designed for routine use in the laboratory, this table is equipped with adjustable lights, a Leica camera, and sliding focusing attachment. Here a botanical chart is being copied by one of the laboratory workers

BOTANICAL PHOTOGRAPHY

For photomicrography, particularly at the higher magnifications which are obtained with the oil immersion microscope objectives, a good photomicrographic camera with an accurate, rigid optical bed is highly desirable. In the absence of such expensive equipment, photomicrography can be carried on successfully with the microscope and any camera having groundglass focusing and from which the camera lens can be removed.

(Photomicrography can also be carried on with cameras from which the lens cannot be removed and which do not have a groundglass for focusing, though this is not so satisfactory. For details the reader is referred to the section on Photomicrography.) A reasonably satisfactory arrangement for photomicrography can be made by carefully aligning camera, microscope, and light source and fastening each securely to the top of a table or to a heavy board.

A motion picture camera operated at long intervals for single exposures by a time-lapse mechanism permits the plant physiologist to record the progress of experiments with plants and to show how plants respond to stimuli and how they grow. Now that satisfactory equipment for this work can be purchased and does not have to be locally designed and constructed it is probable that many physiological laboratories will begin to use time-lapse photography in their work.

In laboratories, much time is saved and expense avoided by keeping accurate data on exposures, distances of lights, etc. Anyone in the laboratory undertaking to photograph a piece of apparatus, or copy a chart, or to do any other type of laboratory or greenhouse photography can then consult the records and determine what exposure will probably be correct for his use.

APPLICATIONS OF PHOTOGRAPHY TO BOTANICAL TEACHING

The value of the visual stimulus is well recognized in all fields of teaching. In few

other fields are the opportunities for visual education greater than they are in the field of botany. The botanical teacher has unlimited opportunities for enriching the instruction with visual aids. Lantern slides, motion pictures, time-lapse motion pictures, enlarged photographs, stereoscopic pictures, photomicrographs all have a part in making the subject matter more real and more interesting for the student, the teaching



SCIENCE MUSEUM. These flower portraits are 16 x 20 inches in size and hand colored with transparent oils. They were made as Kodachrome originals with a 35mm camera. Black and white negatives were made from these color originals, which also provided color guides for the hand coloring.
Natural Science Museum, Syracuse University

more interesting for the teacher. By means of lantern slides and motion pictures, particularly in color, and even more, by means of stereoscopic color pictures it is possible for the teacher of botany to present geographic botany and ecology in a vivid way. These aids permit him to surmount some of the difficulties of having to teach botany in the off season, the winter, when field contacts are impractical. These aids also permit the teacher to surmount in large part the handicap of unfortunate location. While it may be impossible for him actually to transport the class to the Sahauro cactus forest of Arizona, or the majestic groves of Redwood of northern California, or the cypress swamps of Louisiana, or the sand dunes of northern Indiana and Michigan, by means of good color photographs he can give the class some of the sensation of having been there.

Photographic illustrations are of equal value in the teaching of the more technical aspects of plant science. Photomicrographs



SCIENCE MUSEUM. In this exhibit case transparencies of photomicrographs have been used along with greatly enlarged three-dimensional models. Reproduction in one of the fungi is illustrated here—at an exhibit by the Natural Science Museum, Syracuse University

than $\frac{1}{1000}$ of an inch in thickness through the microscope. After studying the details of structure in the various types of cells and tissues through the microscope, the teacher may hand him a tremendously enlarged photomicrograph of the same section, so as to make it seem more like the piece of tissue he has been observing through the microscope, only very much enlarged. The student and the teacher can go over this photomicrograph together and make certain that the student has correctly interpreted what he has seen through the microscope.

and close-up habit photographs make it easier for the students to understand the details of morphological structure and the intricacies of life history; and what is perhaps more important, actually make these technical aspects of the subject interesting.

Photographic illustrations of botany are also of value in the laboratory instruction, in the recitation section, and in the review section. For lecture presentation to large groups, lantern slides and motion pictures are of the greatest utility in helping to make the subject matter tangible and real. In recitation sections enlarged photographs may be of considerable use. In the laboratory there is opportunity for the use of stereoscopic pictures and enlarged photographs and photomicrographs. By means of these, in effect, the student can be transported back or ahead to other seasons and shown stages or conditions of the organism that he is studying which are not otherwise available at the moment. He can also be shown structural details which may not be available for direct observation through the hand lens or through the microscope. Another application of photomicrographs in the laboratory is in making more comprehensible the details of the actual section which the student has been studying through the microscope. For example he may have been examining a thin section of a stem much less

PHOTOGRAPHY AND THE SCIENCE MUSEUM

The resources of the science museums in most colleges and universities are far too limited to permit them to compete with the great natural history museums and the science and industry museums of our larger cities. Nevertheless photography readily permits filling in the gaps where the actual material may not be available for display. Furthermore, photography can be used for telling a more complete story than is told by the display material alone. For example, an exhibit may be set up showing specimens of sugar cane and the products derived from it. The exhibit will be better as a teaching exhibit if colored photographs or colored transparencies are included which will show how the plant looks when alive, how it is cultivated, and how the products are obtained.

Preserved specimens of plants are apt to lose much of their color and to appear less inviting than the living plants. This situation can be corrected by including natural color transparencies along with the displays of preserved plants or plant parts. Some flowers and plant structures are so small that they cannot be seen very well. Along with displays of specimens of this character should go colored photographs or natural color transparencies.

BOX CAMERAS

In the making of diorama cases greatly enlarged photographs can be used for the backgrounds. In these photographic backgrounds, which have been hand colored in transparent oils, the details of vegetation will be shown very accurately. The coloring in by means of transparent oils can be done by following the colors in Kodachrome transparencies which were made at the same time as the matched negatives from which the background has been made.

BOX CAMERAS

Beginners in photography—especially children—appreciate the simplicity of the box camera. This camera is a rigid box, usually rectangular, often with fixed focus, fixed lens opening, and limited speeds. It reduces the mechanics of picture taking to fundamentals so that composition and subject choice can be easily mastered first.

See Also Beginners in Photography, Cameras, How Your Camera Works

BOX CAMERAS, keeping in step with the times, have added so many features to their make-up that they offer a wealth of possibilities to beginning photographers. The startling truth is that the box camera of today, equipped with synchronized flash-guns and other such available accessories, will do work that was impossible for the finest speed camera of the past generation. For the beginner who is primarily interested in getting results in the simplest way possible, there is nothing to compare with the box camera.

Simplicity of operation, lightness of weight, ruggedness of construction, and low price have long been the virtues of this group of cameras. Advantages like these, plus the added picture opportunities which modern improvements open up, make the streamlined box camera the answer to the beginner's camera problem.

Landscapes, outdoor and indoor portraits, moderate action shots, interior shots, silhouettes, still lifes—all these are well within the range of the box camera and can be made in a surprisingly satisfactory way.

THE CAMERAS

A survey of the box cameras on the market today shows that they have *almost* as many variations and combinations of

accessories as cameras of more advanced groups. Some have fixed focus lenses while others are equipped with two-position focusing. Some have built-in accessories, such as filters. Some have "wings" allowing a choice of full or half-size pictures. Others have direct view finders, groundglass, or even reflex finders. Some make snapshots while others offer Time and Bulb exposures.

There are over 23 box cameras on the market today manufactured by Agfa Ansco and Eastman Kodak Companies alone. This summary gives the varying features of the different groups:

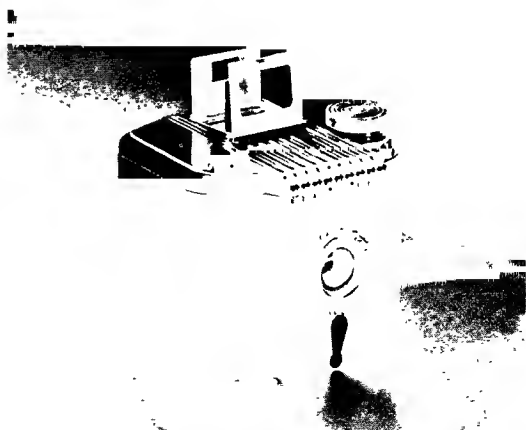
Made by Agfa Ansco Company

1. B-2 and D-6 Shur-Shots

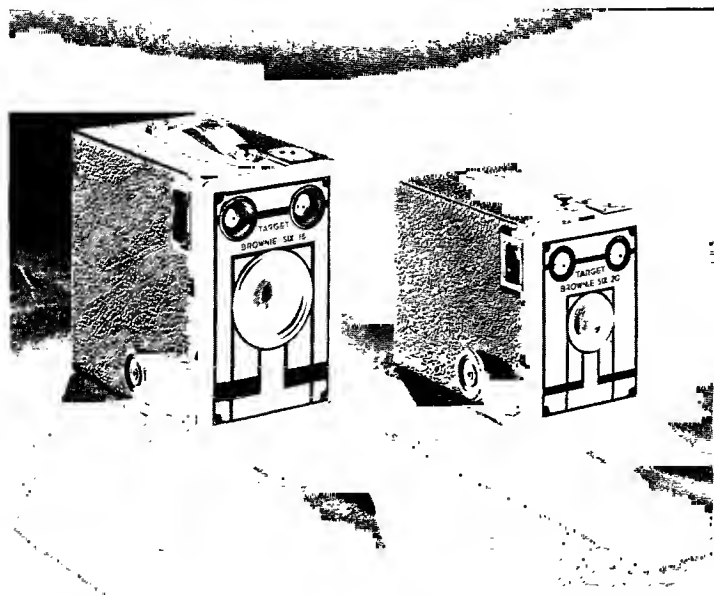
B-2: 8 pictures are $2\frac{1}{4} \times 3\frac{1}{4}$ inch; 16 pictures are $2\frac{1}{4} \times \frac{5}{8}$ inch (Film: B-2 Agfa, 120 Eastman)

D-6: 8 pictures are $2\frac{1}{4} \times 4\frac{1}{4}$ inch; 15 pictures are $2\frac{1}{2} \times 2\frac{1}{8}$ inch (Film: D-6 Agfa, 116 Eastman)

Snapshots and Bulb exposure, built-in wings allowing full or $\frac{1}{2}$ -size pictures, two diaphragm openings, built-in yellow filters, groundglass waist-level view finder.



THE BABY BROWNIE. A rigid and extremely simple box camera, this has only three adjustable parts—the spring view finder, the film winder, and the shutter. Lens is a fixed focus meniscus



BROWNIE TARGETS. Replacing the Eastman Brownies, these cameras have an $f/15$ meniscus fixed focus lens. A draw-out slide provides an aperture of $f/22$. Single-action shutter is adjustable for Bulb and Instantaneous. Portrait lens is attachable

2. B-2 and D-6 Cadets

B-2: 8 pictures are $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film: B-2 Agfa 120 Eastman)

D-6: 8 pictures are $2\frac{1}{4} \times 4\frac{1}{4}$ inch (Film: D-6 Agfa, 116 Eastman)

Snapshots and Bulb exposures, one-way shutter release, 2 large groundglass view finders.

3. A-8 Cadet Flash

8 pictures are $1\frac{5}{8} \times 2\frac{1}{2}$ inch (Film: A-8

flash unit, two-position focusing, built-in yellow filter.

Made by Eastman Kodak Company

1. Baby Brownie

Picture is $1\frac{5}{8} \times 2\frac{1}{2}$ inch (Film: 127 Eastman, A-8 Agfa), snapshots only, folding eye-level finder, fixed focus meniscus lens, and lever shutter release.

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . SPILLWAY

The excellent picture on the opposite page is not only a delightful experience of pattern and rhythm, but it is also a very comprehensive statement about water and light. It is really one of the "wettest" pictures this writer has ever seen. The picture deals with three distinct states of water. First, in the left upper corner, the quiet reaches of a body of water at rest. An almost unbroken smooth surface. As we near the spillway the water becomes restless, until it drops in long white plumes to the next lower level where it boils and seethes. This last state of the water makes a most delightful circular pattern. These three states of water have three distinct patterns. The quiet water is expressed in long horizontal lines formed by the fine ripples of the surface. The spillway itself forms a graceful arch studded with many reflection stars. The secondary pattern of the falling water is formed by the many graceful white jets of miniature Niagaras. The boiling and frothing water in the lower right hand of the picture is a delightful surface contrast to the rest of the sleek and smooth water surfaces. Note the three pieces of driftwood near the top of the picture. These bits of dark solid matter make the water appear doubly transparent and fluid. The camera angle in relation to the sun has been most fortunate. It would not take much imagination to think of parts of the spillway as the "Stars and Stripes."

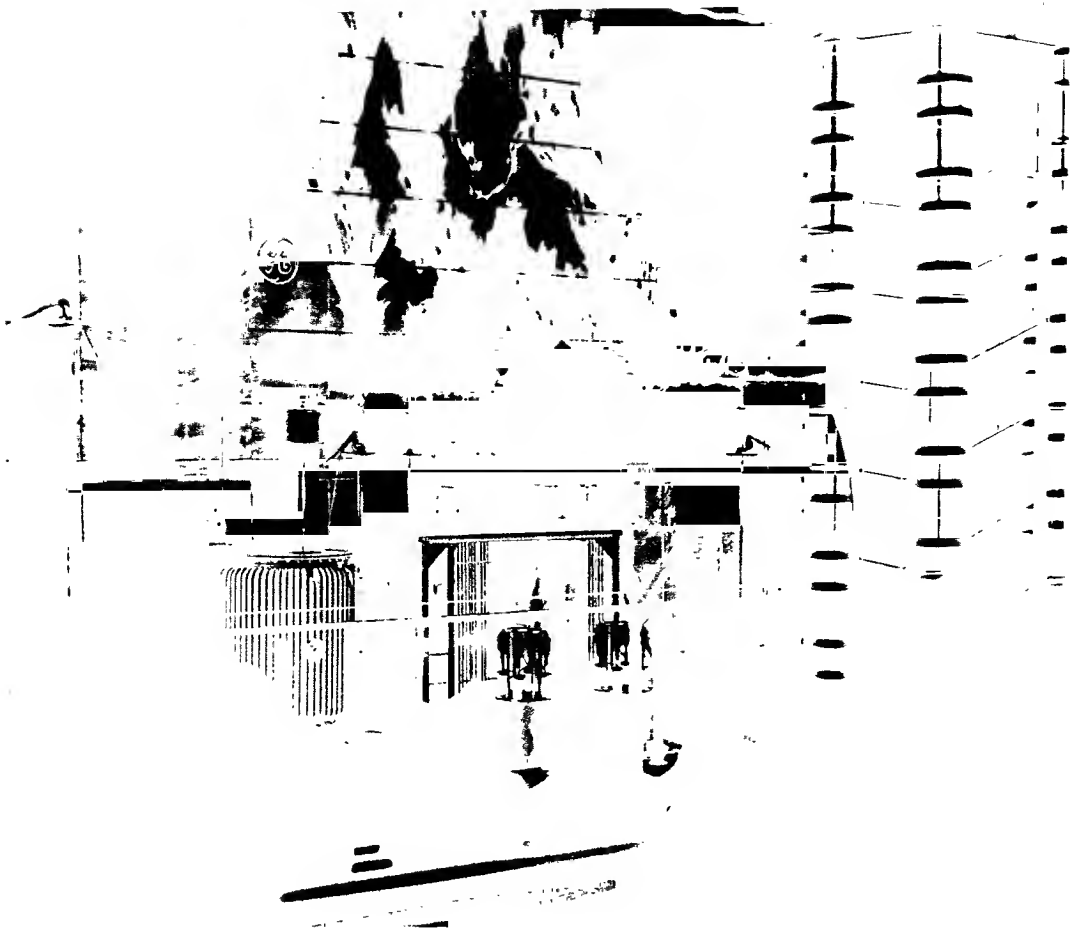
Konrad Cramer



SPILLWAY

This photograph was taken with a box camera on verichrome film

ANNETTE SMITH



MAN-MADE LIGHTNING

JOHN F. O'REILLY

This picture was taken at General Electric's show at the World's Fair. Ten flashbulbs were set up to illuminate the transformers and the background. When the show started the bulbs were flashed, then the shutter was closed.

As each new bolt of lightning was made, the shutter was opened and closed again

Account—Crowell Publications Agency—Fuller, Smith & Ross Gray O'Reilly Studios



ON RELIEF

CHESTER

The low key effect of this backlit scene gives just the right impression of depressing darkness. Taken with natural light entirely, a flash lighting up the entire scene would obviously have spoiled the picture. Here we can get, by edgelighting, just enough of the facial expression of the men on the bench. And notice the silhouette stance of the man in dead center. DATA: Rolleiflex, extra fast film



CHECKERS

GEORGE FRENCH

Here the documentary and pictorial technics are combined—a difficult thing to do. The photographer is noted for his careful and sympathetic studies of real people in real poses. And detailed though the shot is, there is none of that harshness which many documentary photographers so often inject into their pictures

BOX CAMERAS

(Continued from page preceding insert)

2. *Baby Brownie Special*

Picture is $1\frac{3}{8} \times 2\frac{1}{2}$ inch (Film: 127 Eastman, A-8 Agfa), snapshots only, fixed focus meniscus lens, enclosed eye-level view finder, plunger shutter release, tripod socket.

3. *Brownie Juniors*

Six-16 Model: Picture is $2\frac{1}{2} \times 4\frac{1}{4}$ inch (Film size: 616 Eastman, PD-16 Agfa)

Six-20 Model: Picture is $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film size: 620 Eastman, PB-20 Agfa)

Snapshots and time exposures, fixed focus meniscus lens, groundglass waist-level view finder.

4. *Brownie Targets* (Replacing Brownies)

Six-16 Model: Picture is $2\frac{1}{2} \times 4\frac{1}{4}$ inch (Film size: 616 Eastman, PD-16 Agfa)

Six-20 Model: Picture is $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film size: 620 Eastman, PB-20 Agfa)

Meniscus lens, two-opening diaphragm, fixed focus, Bulb and Instantaneous, portrait lens available.

5. *Brownie Specials*

Six-16 Model: Picture is $2\frac{1}{2} \times 4\frac{1}{4}$ inch (Film size: 616 Eastman, PD-16 Agfa)

Six-20 Model: Picture is $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film size: 620 Eastman, PB-20 Agfa)

Snapshots and time exposures, enclosed eye-level view finder, two-position focusing lens.

6. *Bullet*

Picture is $1\frac{1}{2} \times 2\frac{1}{2}$ inch (Film: 127 Eastman, A-8 Agfa), snapshot and Bulb actions, folding eye-level direct view finder.

7. *Six-20 Bull's Eye*

Picture is $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film: 620 Eastman, PB-20 Agfa), fixed focus, snapshot and Bulb actions, tubular optical eye-level finder.

8. *Six-20 Flash Brownie*

Picture is $2\frac{1}{4} \times 3\frac{1}{4}$ inch (Film: 620 Eastman, PB-20 Agfa), snapshots and photoflash pictures, used with or without synchronized flash holder, snapshots and Bulb settings, two-position focusing, enclosed eye-level view finder.

9. *Brownie Reflex*

12 pictures are $1\frac{5}{8} \times 1\frac{5}{8}$ inch (Film: A-8 Agfa, 127 Eastman), snapshots and Bulb exposures, full negative-size reflex view finder, tripod socket, synchroflash unit available.

Whether you are buying your first box camera or exploring all the possibilities of the one you have, there are important things you should know about picture sizes, lenses, shutters, view finders, focusing devices, films, and accessories.



BROWNIE SPECIAL. For children, the box camera is ideal, as photography is reduced to fundamentals. The design should be simple and the camera easy to handle. Notice the up-and-down plunger type of shutter, to avoid motion of the camera during exposure

LENSES

Give your lens a chance!

Failures with box cameras can occur only when the photographer fails to understand the limitations of his medium. The first essential is to know just what your lens will



AGFA B2 CADET. This is Agfa's version of the completely simple box camera—with a rotary shutter, provision for Time and Instantaneous, and a ground-glass view finder

do. People who would not think of asking their 4-cylinder automobile to perform like a 16-cylinder one will think nothing of pointing their box camera at a coal bin on a rainy day at 5:00 P.M. to make a picture.

Just make up your mind that there are certain pictures which your camera will not be equal to. Don't ask it to do the impossible.

Box cameras are equipped with lenses designed for beginners who do not want to bother with focusing, lens adjustments, or shutter speeds. These lenses must necessarily be of comparatively small aperture and a single shutter speed.

There are two groups of such lenses. One group is composed of single meniscus and doublet lenses. These have a fixed focus and an aperture opening corresponding to $f/15$. Objects closer than 8 feet to the camera will not be sharp or clear. Cameras which are equipped with this type of lens are Baby Brownie, Baby Brownie Special, the Brownie Junior, the Brownie Reflex, the B-2 and D-6 Shur-Shots, the B-2 and D-6 Cadets, the A-8 Cadet, the Agfa Pioneer, the Eastman Bullet, the Six-20 Bull's Eye. Meniscus lenses are extremely satisfactory

on distant views and on subjects 8 feet or more from the camera. They can also be used for night snapshots if used with photoflood lamps or with various kinds of flash equipment.

The second group of simple lenses includes the Kodak Diway, Twindar, and Bimat lenses. These are capable of simple focusing, allowing the operator to stand within 5 feet of the subject. They are capable of two-stop lens diaphragm openings, ranging from $f/11$ to $f/15$. Lenses of the second group are excellent for close-ups of people (within 5 feet) and for photographing small objects, pets, etc. They can also be used for snapshots at night, either with photoflood lamps, with hand flash equipment, or with synchronized flash units. Box cameras equipped with these lenses are the Brownie, Six-20, Six-16, Brownie Special, and Agfa Chief.

One more thing needs to be said about lenses. The Agfa B-2 and D-6 Shur-Shots are equipped with an extra refinement in the form of two-diaphragm openings. These two openings permit control of the amount of light entering through the lens; and they impose a little more responsibility on the operator of the camera. On an especially bright day or when photographing beach scenes or broad, bright landscapes, the smaller lens opening is used. The larger opening, which allows more light to pass through the lens, should be used on dark days, in the deep shade, or when photographing dark objects.

SHUTTERS: TIME AND BULB

It is equally important that owners of box cameras understand the possibilities and the limitations of their shutters.

A simple camera shutter is nothing more than a thin metal blade so arranged and placed behind the lens that it prevents light from passing through the lens onto the sensitive film in the back of the camera. The blade, operated by an ingenious system of springs, opens and admits light to the film whenever the photographer moves the "shutter release."

Box cameras are equipped with shutter devices for instantaneous or snapshot exposures ("I" on the camera), Bulb and Time exposures ("B" and "T").

The "I" setting is used for snapshots. It represents a shutter speed of 1/30 to 1/50 second.

"B" (Bulb) is the setting to use for short time exposures. The release is held down during the duration of the exposure, then pulled back up when the time is up. A bulb exposure should last several seconds only, as the hand on the release will cause some vibration.

The "T" (Time) is the setting which gives great additional possibilities to the box camera operator. Pictures of still subjects outdoors can be made on very dull days, and a great many indoor pictures can be made with this device. The shutter opens when the release is pressed down, and remains open until the release is pressed down for a second time. Time exposures may last for as long as the photographer wishes.

"B" and "T" settings are most useful for interiors, for pictures with photoflash bulbs, and for outdoor night pictures. When these settings are used the camera *must* be placed on a steady support—a table will do if a tripod is not available.

Shutter releases are of several types. Some work on the lever plan, others are of the plunger type. In general the shutter releases involving an up-and-down motion are more satisfactory than those using a side-ways motion, as there is less likelihood of camera motion.

VIEW FINDERS

There are five different kinds of view finders available on box cameras. Operators express varying preferences for these different finders. Where children are involved the eye-level wire frame view finder is most satisfactory, for it allows a full, upright view of what is

going to be in the picture. However, greater care must be exercised to hold the camera steady when an eye-level finder is used.

The five types of view finders are:

1. *Reflecting groundglass finders*

This is the old style and most common view finder. It is composed of a small lens, a mirror, and a groundglass, giving an image in a small "window" on top and sometimes on one side of the camera. This finder has the disadvantage of being small and a little foggy on account of the groundglass. It shows the image upright but reversed from left to right. Used on Brownie Juniors, Agfa Shur-Shots, and Agfa Cadets.

2. *Reflecting brilliant finders*

This shows the image formed on a second lens instead of the groundglass. Though



BROWNIE REFLEX. This camera, taking 12 pictures of 1 5/8 x 1 5/8, has a full negative size reflex view finder. In addition there is an instantaneous and Bulb adjustment. Notice, too, the neck strap and provision for using a flash synchronizer



EASTMAN SIX-20 BULL'S EYE. This box camera takes a large film size, $2\frac{1}{4} \times 3\frac{1}{4}$. Its special feature is an optical eye-level finder. The top lever controls Instantaneous and Bulb, while the bottom lever is the shutter release

still small, it is more efficient because the image is more brilliant.

Caution: The user's eye should be directly over the finder. This is more important here than in the groundglass finder. Used on Six-20 and Six-16 Brownies.

3. *Direct vision wire frame finders*

These practical, efficient finders permit the operator to look through a small wire frame and see directly what he is getting on the film. Used on the Baby Brownie, the A-8 Cadet Flash, and the Bullet.

4. *Direct vision tubular finders*

This is a small telescope in reverse, giving a reduced instead of a magnified image. Used on Baby Brownie Special, Brownie Special, Six-20 Bull's Eye, Agfa Chief, and Agfa Pioneer.

5. *Reflex View Finder*

This is used only on the Brownie Reflex. It is the most efficient finder of all as it permits a brilliant, upright image exactly the size of the picture.

PORTRAIT ATTACHMENTS AND FILTERS

Among the valuable accessories now available for box cameras are portrait attachments and filters.

The Kodak Portrait Attachment No. 3, when fitted on the Baby Brownie Special, the Six-20, and Six-16 Brownie Special, will permit focusing up to $3\frac{1}{2}$ feet of the lens. This gives large head and shoulder portraits, close-ups of pets, table top groups, and still lifes.

These portrait attachments are available for Agfa boxes:

Size No. 20—for A-8 Cadet Flash

Size No. 22—for B-2 Cadet and B-2 Shur-Shot

Size No. 23—for D-6 Cadet and D-6 Shur-Shot

Color filters are available for box cameras but unless the photographer can buy a second-hand filter it will hardly pay him to make the investment. The least expensive color or sky filters cost \$1.25 to \$1.50. Several boxes are equipped with built-in color filters which are a great addition to their usefulness. The Agfa Shur-Shot has a built-in color filter and the Agfa Chief has a haze filter.

FLASH UNITS

The flash unit is the greatest innovation in box camera manufacture. Both Agfa and Eastman put out such box cameras, equipped with a built-in synchronizing mechanism and fitted with a detachable flash reflector unit.

The Six-20 Flash Brownie is sold with or without the detachable flash holder and so can be used for daylight snapshooting as well as for night flash work. The Agfa A-8 Cadet Flash camera also comes equipped with a dependable synchronizing mechanism and a detachable flash unit.



AGFA PIONEER. With this box camera, a synchronized flash unit may be used, if desired. And the difficulties of indoor and night exposures are automatically overcome. Other features are an optical view finder, shutter release built into the body, slip-on lenses, if necessary. Comes in two sizes: $2\frac{1}{4} \times 3\frac{1}{4}$ and $2\frac{1}{2} \times 4\frac{1}{4}$

BOX CAMERAS

Available for use with all box cameras equipped with B or T settings is the simple hand flash. This is an inexpensive accessory which will repay its users many times by the fine flash pictures which it makes available. The hand flash resembles a regular flashlight, except that it is fitted with a reflector. In using it, the photographer simply places his camera on a tripod or other firm foundation, opens the shutter, sets off the flash as if it were a regular flashlight, then



LOADING THE AGFA CADET. The cause of most box camera troubles lies in loading the film. Care should be taken that no undue bright light strikes the film or else edge fog will result

closes the shutter immediately. If the Bulb setting is used, the lever is held down during the flash; if the Time setting is used, the shutter is opened naturally and then closed with a second motion—after the flash has been set off. The use of the hand flash with box cameras has provided some splendid pictures of night groups.

TRIPODS AND CARRYING CASES

Tripod sockets, permitting the use of tripods for indoor work and outdoor work on dull days, are a great addition to the three cameras equipped with them. The Brownie Reflex and the Brownie Specials—Six-20 and Six-16—have these tripod sockets.

Carrying cases having slide fasteners and shoulder straps are available for the Six-16 and Six-20 Brownie Specials.

FILMS FOR BOX CAMERAS

Agfa's Plenachrome and Eastman's Verichrome are the best all-purpose films for day-



AGFA SHUR-SHOT. The special feature of this box camera is the built-in yellow filter. The sliding bar at the side swings a filter into place and permits a choice of two diaphragm openings

light snapshots. These films are by far the most dependable for box camera operators, and they are available in all the box camera sizes. For outdoor snapshots on dark days, there are Kodak and Agfa supersensitive films.

HINTS FOR USING YOUR BOX CAMERA

Astonishingly fine results are possible with box cameras. The only essential is that the operator understand the limitations of his medium and not try to make a box camera perform like a super speed reflex.

These hints may help you to get better results with the different subjects you will be taking with your camera.

Landscapes. The meniscus lens on the box camera will give a soft focus effect that is sometimes sought with much zeal by advanced photographers interested in achieving diffused pictorialism.

Use a filter, if possible, to bring out the cloud effects in your landscapes. If your camera is a B-2 or D-6 Shur-Shot, or an Agfa Chief, don't neglect the built-in color and haze filter. Use this whenever there are clouds in the sky or when you are making an outdoor portrait with the sky as a background.

Outdoor Groups. This type of subject is usually the most popular with box camera operators. Try to arrange your group in pleasing, graceful positions. Choose attractive backgrounds. Try to have your subjects seated, or have some seated and some stand-



SIX-20 FLASH BROWNIE. Shots may be made with or without the synchroflash holder, at Instantaneous or at Bulb. Notice the eye-level finder and the two-position focusing

ing. Have them doing *anything* but standing stiff and straight in a row to "have their picture made."

Stand as close to the subject as possible, which will mean within 5 or 8 feet depending on the type of camera you have. Fill up the view finder with the *subject*—not a lot of worthless background which will show that you stood too far away.

Outdoor Portraits. Buy a portrait attachment and move in close to make head and shoulder portraits of your friends. Have them stand about 3 feet away from some plain background—like a wall, a solid fence, a huge tree, or in an open space where you can use the sky as a background. If your camera is one of the Shur-Shots, slip the built-in color filter into place, put a portrait attachment over the lens, and capture a fine outdoor head study backed by the sky.

If your camera has a synchronized flash unit, try an outdoor portrait with the sun furnishing a backlight. This way you can point your camera straight into the sun at your subject.

These pleasing backlighted effects are also good for groups of two or three people.

Action Pictures. You can catch many action pictures with your shutter speed of 1/30 to 1/50 second—but don't try to "stop" a speeding locomotive, a leaping hurdler, or even a child (close-up) playing actively with his toys. If you want to make these pictures, buy another type of camera with faster shutter.

Three things determine how successful you will be in stopping action—the speed of the subject, the angle of the camera, and the distance of the subject from the camera.

Remember that action subjects coming *toward* or *going away* from the camera are twice as easy to get. Don't try to stop fast action which passes direct *across* your field of vision. Remember, too, that the greater the distance from subject to camera, the less shutter speed is needed to stop the action.

Indoor Portraits. By using a couple of photoflood lamps in reflectors, the box camera operator can make quite satisfactory indoor portraits. If enough lights are used it will not be necessary to use the Bulb setting on the shutter. Try using a No. 1 and a No. 2 Photoflood lamp, in handy paper reflectors, on each side of your subject and about 4 feet away from the subject. Study the articles on lighting before setting up your photoflood lamps.

Keep your backgrounds simple in these pictures.

Use a portrait attachment so that you can work within 3½ feet of your subject.

Try making a portrait with the synchronized flash, if your camera is equipped with a flashgun. If not, try using an open hand flash.

Always place your camera on a steady base, unless using the synchronized flash unit.

Use fast pan film for your indoor work.

Still Life. There is no reason why box camera operators should not venture into the fascinating field of still life photography. To be successful at this work you should use a portrait attachment to increase the size of the objects on the negative.

The Time and Bulb device on your camera comes into use here. The shortest time exposure that you give will be almost six times longer than the usual snapshot.

For the best still life pictures, use medium pan film and a time exposure. From a properly exposed negative you can have very satisfactory enlargements made of your still life compositions.

DON'TS FOR BOX CAMERA OPERATORS

Remember these basic cautions, if you want to get the most from your box camera:

1. Don't try to stop action which is faster than 1/50 second.
2. Don't try to make snapshots when the day is too dark.
3. Don't move the camera when making the exposure.
4. Don't stand too close to the subject if the minimum focusing distance of your lens is 5 to 8 feet.
5. Don't fail to put the lever back to "T" after making a Time or Bulb exposure.

BOXING AND WRESTLING PHOTOGRAPHY

Kenneth Walmsley

Sports Director, National Studios, New York City

Photography has many special fields and, as a profession, it presents almost endless possibilities. Here is an expert on photographing boxers and wrestlers who tells of the pleasure and profit he has gotten out of specializing. He shows that there is a trick in every trade—especially in commercial photography.

See Also Portrait Photography, Sports Photography

PRIZE fighters and wrestlers, like movie stars, get a lot of fan mail and have a great need for photographs. Besides that, most of them just naturally like having their pictures made. So my business is on something of a quantity-production basis. Orders are large. Fighters want pictures by the hundred, not by the dozen. A busy fighter will use as many as 1500 pictures in a year. In my files are pictures of all the big fighters of the last two decades. The experience I have gained in this work is at the disposal of any amateur or professional photographer who wants to make a hobby or a business of photographing boxers and wrestlers. It is interesting work in a specialized field—and all it takes is a love of sports and a knowledge of photography!

TYPES OF PICTURES

First you must know the three general types of pictures that fighters want:

The press picture, which their managers seek to get into newspapers, is usually an 8 x 10 glossy print. This size picture, on semi-matte paper, is also preferred for presentation to the man's friends and to his fans. I make these for up to \$25.00 a hundred.

For sending out to promoters the fighter wants 5 x 7 or 5 x 8 prints in four different



BILLY CONN. This shot shows Conn, noted heavy-weight boxer, in a characteristic pose
Photo, National Studios

TECHNICS OF PHOTOGRAPHING FIGHTERS

Boxers and wrestlers pose in their togs. To make it easy for the boys I keep ring togs and gloves in my studio.

The lighting set-up for these pictures is simple and follows a more or less set formula. We put two spots on the fighter's face, two photofloods on the background, and strive for something of a flat picture—since this is the kind that will show the fighter's muscular development and stance to the best advantage.

As for exposures, I use the open and close shutter, usually at about 1/10 second with Super-XX film and enough light so that I can stop down to f/16.

Backgrounds are kept simple, usually only a plain white wall lighted separately to give a white background.



FRITZIE ZIVIC. This and the accompanying photograph show Zivic, welterweight boxer and former champion, in the two poses usually taken by boxing photographers. Such photographs are useful not only for publicity but also for use in securing fights
Photo, National Studios

poses. These must be carefully executed to show the man to great advantage, for it is these pictures which get him his good matches. This size I make up for \$15.00 a hundred.

Big-time fighters often order the special enlarged picture which we make up in the 20 x 30 and 30 x 40-inch size. These portraits, usually full-length and in fighting togs, are hand colored in oil. Fighters often ask for a painted inscription on these—"To Lou from Pete," etc. They also like to have these hand-colored oil portraits of themselves so that if they ever open a restaurant they'll have the picture to hang over the bar.

In addition to these three large groups of pictures, we also make up quite a quantity of special Christmas cards for the fighters.



FRITZIE ZIVIC. Backgrounds in pictures such as this must be extremely simple. The purpose of this type of photograph is not to create a work of art, but to show the fighter to best advantage
Photo, National Studios

BOXING AND WRESTLING PHOTOGRAPHY

The most important thing about a fighter's portrait is his stance. He must look in the picture as he looks at his best in the ring. This pose is sometimes difficult to get in the studio. We get the man to spar around at shadow boxing for a while before he takes a post. I stand in front of him and watch him sparring, and when he falls naturally into an effective position I get him to hold it. Every fighter's style is different, and this is the only way I know to get a real picture of the man as he looks in action. Sometimes I have to make slight changes in the stance, but only to correct certain minor flaws that would show to disadvantage in a picture.

We generally make four poses. A full front view. A view from the left side. One from the right. And a three-quarter shot which can be used just as it is or to make a bust portrait in an enlargement. These head shots are usually what the fighters want on their Christmas cards.

The left paw should always be the one extended. And it should not be too far out from the man's body. The typical left-handed stance is one with the left hand out, the left foot forward, and the back foot on tip toe. This is the model pose for each of our pictures

Sometimes a left-handed boxer will want pictures of himself as he would appear in a right-handed stance. This is necessary because left-handed boxers are usually unpopular with matchmakers. It would look pretty unconvincing to have a left-handed fighter take a right-hander's stance, so I solve the problem by reversing the negative in printing—and the boxer has his pictures for the promoters!

Another service that we offer fighters is the removal of patches, cuts, and bruises from their pictures. This is a simple matter of retouching the negative—and it is often a necessary device when photographing a fighter during his big season. And naturally no fighter wants to look battered!



THE ANGEL. The purpose of wrestler photos is not so much to show form as to show toughness. The heights of toughness are reached in this picture, which uses the extreme angle and weird flash lighting to amazing advantage. DATA: 4 x 5 camera, 13.5cm lens, ortho film, 1/200 second, f/11, flash lighting

Photo by Arthur Sasse, International News Photo

The fighters never have a smile on, naturally. At the same time they don't want to look too tough.

TECHNICS FOR WRESTLERS

With wrestlers it is different. The tougher you can make them look, the better they like it.

The object in wrestlers' pictures is to show as much muscle as possible. The typi-

MATTHEW B. BRADY

Robert Taft

*Author of Photography and the American Scene;
Professor of Chemistry, University of Kansas*

Matthew Brady's Civil War pictures constitute perhaps the world's most famous photographic collection. In this article, a well-known photographic historian tells of the career of a man who was one of America's first and best war and documentary photographers.

*See Also Armies at War, Documentary Photography,
History of Photography, War Photography*

cal wrestlers' poses are the ones showing the head-on shot with hands spread out, the right hand out to grab the opponent's hair, and the crossed arm pose. We sometimes vary these with "candid" shots which are designed again to show the man's muscular development—such acts as the wrestler breaking a big stick with his hands, or chopping a huge log, etc. Sometimes, for publicity, the standard wrestling pose is varied, or there may be straightforward portraits like the one of All Billings shown below. But the general impression to give is—toughness.

SPECIAL USES FOR PICTURES

Bars often want murals made of fighters' pictures. I have designed and executed many of these.

Another interesting piece of work in this line is to arrange a collage of pictures of the great fighters of the past, combined with those of the present. This I can usually do from my own files. It is interesting to see the changes in style of ring togs and in the poses which fighters took through the years.

For the amateur or professional who is interested in boxing and wrestling as a sport, I can recommend no more interesting phase of photography than this.

MATTHEW B. BRADY, the best-known professional photographer in the history of American photography, was born about 1822, in Warren County, New York, near Lake George. He was the son of Irish immigrants. In the late 1830's he became a resident of Saratoga Springs, where he became acquainted with the artist, William Page. Brady here learned the trade of maker of jewel and miniature cases, and took lessons in painting from Page. About 1839 both men moved to New York City where Page introduced Brady to Samuel F. B. Morse, who in turn had been Page's instructor in art. Morse had just returned from Europe where he had seen the results of Daguerre's wonderful invention and he

himself had begun the practice of the new art of photography. Brady became fascinated, too, by the process which could, for the first time, reproduce in facsimile any given scene. So great was his interest that he took lessons from Morse in this newest of professions. It was not for several years, however, that Brady was able to acquire the necessary capital and skill to launch into the business of "Daguerreotypy" for himself. Finally, in 1844, he rented some rooms on the top floor of a building at the corner of Fulton Street and Broadway and began the career which led to his lasting fame.



AL BILLINGS. There are no particular stock poses for wrestler photos. This one is a straight portrait and is used chiefly for publicity and for gift photographs
Photo, National Studios



MATTHEW B. BRADY. This portrait of the great Civil War photographer was taken in about 1875

EARLY PHOTOGRAPHIC WORK

Brady took up his new work with enthusiasm. He was young, energetic, enterprising, and industrious, and he devoted himself unreservedly to the new craft. He attempted to raise the new profession to the dignity of the older arts. He was not alone in this attempt, of course, for Jeremiah Gurney, also of New York, John A. Whipple and Southworth and Hawes in Boston, Marcus Root in Philadelphia, J. H. Fitzgibbon in St. Louis, and Alexander Hesler in Chicago—all contemporaries of Brady—were striving toward the same end. But the majority of early workers in Daguerreotypy were men of little talent and vision. Men of native ability, such as Brady, were bound to succeed. They were willing to devote their entire interest to the craft, to learn each

step of the new art, not only by doing but by reading all that was published on the subject, to experiment when the day's work was done, and to consult chemists and artists for any aid they might furnish. Brady, for instance, was one of the first, if not the first, to introduce the innovation of a large skylight as part of the equipment of the photographer.

It is not due to mastery of technical details, important as they were, that causes Brady's name to be remembered to this day. He conceived another venture the year after he first became a professional Daguerreotypist. This idea, which was to remain a guiding principle with him for most of his long career, was the project of collecting the portraits of all the distinguished individuals whom he could induce to sit before his camera. With this end in view, he entered public competition to attract attention, advertised widely, began the publication of lithographed portraits of notables. He opened, in 1847, a temporary gallery in Washington during the sessions of Congress. As a result of this initiative, Brady became by 1850 the fashionable photographer of the times and the list of individuals who sat for Brady during the Daguerreotype era reads like a roster of all the country's historic names. The breadth and scope of this phase of Brady's career is best illustrated by the fact that he photographed, with one exception, every President of the United States from John Quincy Adams, the sixth Presi-



BRADY'S EQUIPMENT. Brady's plates, being wet, had to be developed within 10 minutes of the exposure. As a result, this clumsy cart was taken onto the battlefields—to carry the voluminous equipment necessary
Brady Photo, from U. S. Signal Corps

dent, down to and including William McKinley, the twenty-fifth President. Not all were photographed during their term of office, as Adams, for example, was President from 1825 to 1829, before Daguerreotypy was introduced. The lone exception to Brady's remarkable record was William Henry Harrison, who died a month after his inauguration, and three years before Brady began his photographic career.

Brady's reputation was still further enhanced when he went abroad in 1851 to exhibit at the Crystal Palace Exhibition in London, the first international competition among Daguerreotypists and photographers. Only three medals were awarded Daguerreotypists in the Great Exhibition and all three went to Americans. Brady was awarded one for a collection of forty-eight portraits. M. M. Lawrence was awarded one for a large ($10\frac{1}{2} \times 12\frac{1}{2}$) portrait Daguerreotype, and John A. Whipple of Boston re-

ceived the third for Daguerreotypes of the moon which were regarded as indicating the beginning of "a new era in astronomical representation."

The considerable discussion of Brady's career in days prior to the Civil War has been purposely made as this period represents a contribution of Brady to American history of equal importance to his better known work during the Civil War.

While abroad in 1851, Brady became acquainted with the paper and wet plate processes, the latter having just been introduced. On his return home, Brady soon put into practice the result of his observations and was one of the first professionals to use the wet plate process.

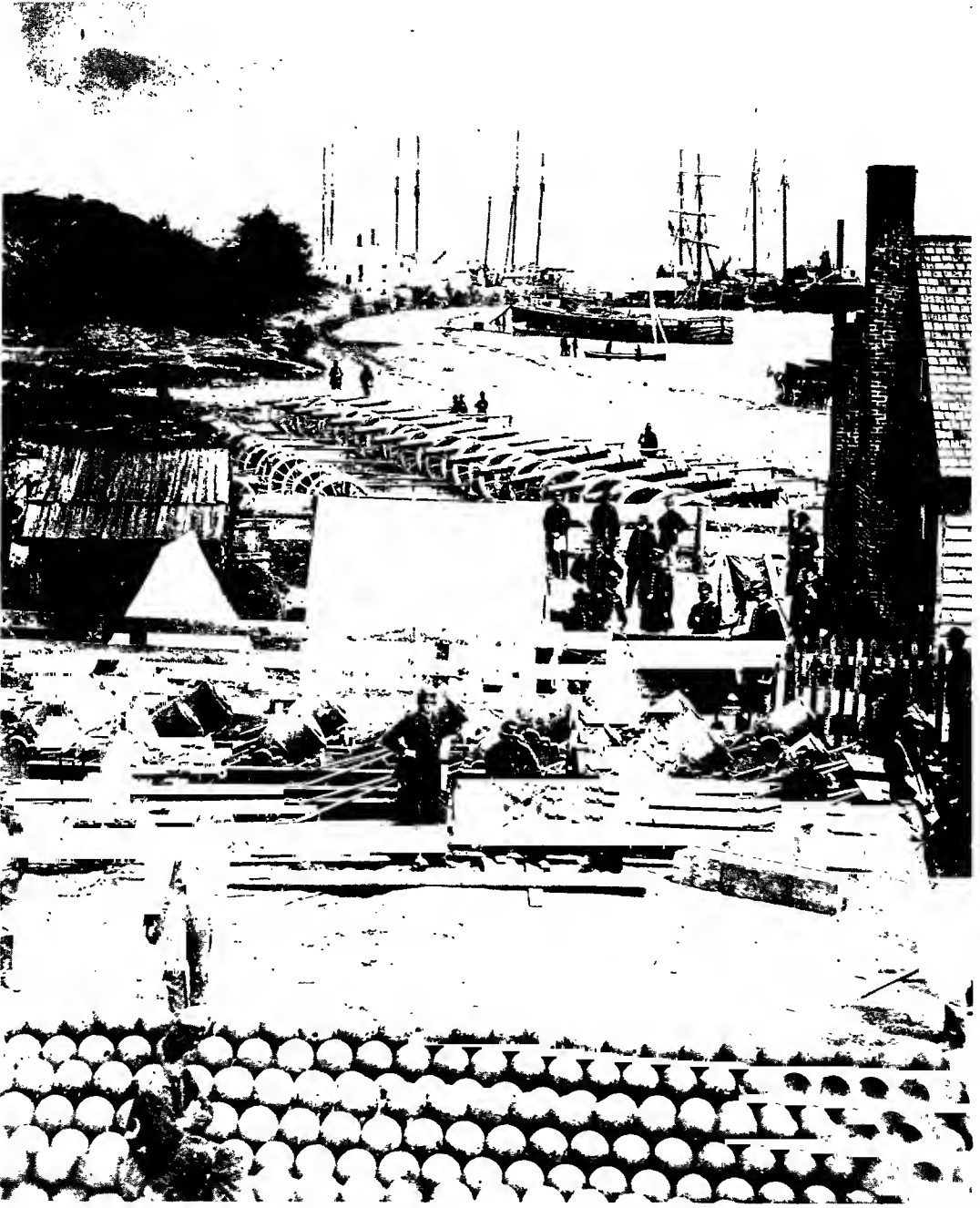
In the middle 1850's, Alexander Gardner, a Scotch expert on enlarging, was brought by Brady from abroad to practice still another new development. As a result "imperial photographs," huge prints as large



DESTRUCTION. This is all that was left of some American city—after a few days of Civil War fighting. The starkness and completeness of the destruction have been captured by Brady's camera and the print speaks volumes
Brady Photo, from U. S. Signal Corps

as 17 x 20, were introduced to a delighted and amazed public. As success resulted from these ventures, Brady undertook still another. In 1858, a permanent branch

gallery was established and Brady's name became one of the best known of his day. For this pioneering work in commercial photography, Brady deserves much credit.



YORKTOWN, VIRGINIA—1862. An ammunition depot near the Union front. This shows in remarkable detail the condition and calibre of the fighting equipment, the dress and attitude of the soldiers and officers. The exposure must have been for several seconds' duration, as the men have obviously been posed, and there is slight movement in a few figures. But notice the exceptional depth of field, the detail in the very near foreground and in the distant harbor scene

Brady Photo, from U. S. Signal Corps

CIVIL WAR WORK



ARMY HOSPITAL. Rarely could photographs be taken indoors by Brady. But this photograph was well worth the trouble, as it gives a wealth of information on hospital conditions during the Civil War. Notice the young boy at the right
Brady Photo, from U. S. Signal Corps

With the outbreak of the Civil War, Brady's absorbing passion determined his career. Although he had achieved a considerable competence and was by nature a cosmopolite and a good liver, fond of the comforts of life, a spirit within him forced him to the rough-and-ready life of the road and the camp.

The self-appointed pictorial historian of his age decided to record by means of the camera the most important event in American history during the nineteenth century.



LINCOLN AT ANTIETAM. Brady's Civil War groups had to be carefully posed, of course. Here is a remarkable group portrait showing President Lincoln and some of his officers. From left to right: Col. Delos B. Sackett, Maj. Monteith, Gen. N. B. Sweitzer, Gen. G. W. Morell, unknown, Gen. George B. McClellan, Scout Adams, Col. Alexander S. Webb, Gen. G. A. Custer, President Lincoln, Gen. H. G. Hunt, Gen. Fitz John Porter, Pinkerton, Col. Fred Locke, Gen. A. A. Humphreys, Col. Batchelder, Ordnance Officer
Brady Photo, from U. S. Signal Corps

Organizing a staff of photographers, which at one time numbered as many as twenty professionals, Brady equipped them and sent them to the various fronts. Among the staff who took the field for Brady were Alexander and James Gardner, T. H. O'Sullivan, T. C. Roche, S. C. Chester, David Knox, and many others. Brady himself was frequently in the field and on several occasions was under fire. Of the thousands of wet plate negatives thus secured largely by skill, courage, and expense, only a small fraction was made by Brady himself but the credit for the venture should go largely to Brady, as it was his idea and he directed and financed it. Over a hundred thousand dollars was spent in the venture, from which Brady had only a small return; but the publication of the ten volume work *The Photographic History of the Civil War*, in 1911, constitutes a memorial that will give the name of Matthew B. Brady to posterity.

Brady's important and historic negatives have had a long and complex history. Many were made in duplicate and triplicate and as a result there are several collections still extant. The largest of these is in the possession of the Signal Corps of the United States Army and numbers some six thousand items. Prints from many of these negatives are still obtainable at reasonable cost. An examination of the catalog of the collection shows that it contains not only the Brady Civil War views but portraits of hundreds of well-known figures in American life before the War, as well.

AFTER THE WAR

At the close of the war, Brady fell on evil days. The large investment in the Civil War photographs and their poor return were followed by a national depression in which Brady lost nearly all his possessions. After the War he continued to practice in Wash-



STEAMBOAT CANNON. This imposing weapon was mounted on the stern of a river steamboat, presumably for river fighting. Notice the equipment needed for firing, the rammer and the cannon balls
Brady Photo, from U. S. Signal Corps

ington, at first with some success. But as the years passed his fortunes rapidly receded. His place as the fashionable photographer of the day had been taken by Napoleon Sarony and J. M. Mora and Brady was never able to regain it. When he died in New York City on January 15, 1896, he was alone, friendless, and penniless. Only the collection of a sum of money by a few friends who learned of his death saved from burial in Potters' field one of the greatest men in photographic history.

BRIGHTNESS RANGE. Brightness range refers to the range of contrasts in the light reflecting from the subject to be photographed. The brightness range of a subject stretches from its deepest shadows to its most brilliant highlights.

Two things affect the brightness range of a subject: the brilliancy of the sun and the range of contrasts in the subject itself.

The highest brightness range possible occurs when there are extremely black shadows and extremely bright sunlight. The lowest brightness range is in the scene of exactly the opposite tone—one in which the contrasts are few and the tone values are in approximately the same place. An example of a scene of highest brightness range might be one with a dark tree casting shadows in the foreground, a sunlighted concrete highway in the middle ground, and white cumulus clouds in the sky background. The same landscape might have a low-key brightness range on a murky day when the highway was shrouded with mists and the sky was a drifting fog putting a gray tone over the whole scene.

The brightness range of a subject affects the exposure and development of the negative. A scene with extremely high brightness range is difficult to record. Film latitudes have recently been developed to such a degree of perfection that they can record much greater brightness ranges than was ever possible in the past. Even yet, however, there are extremes in light contrasts which are too great for modern emulsions.

As the brightness range of the subject increases, the gamma or degree of development required to produce any given range of densities decreases. In a subject of low

brightness range a high gamma is necessary in development.

Therefore some photographers overexpose and underdevelop their negatives in recording scenes of extremely high brightness range. In scenes of low brightness range they use the opposite device of underexposing and overdeveloping the negative. (See also *Gamma*.)

BRILLIANCE. Brilliance in negatives and prints should not be confused with mere contrasts for it refers to the quality as well as the variation with which the brightness values of the subject are recorded.

A print is said to have brilliance when it has a small area that is quite white, a small area that is quite black, and a good range of varying gray tones in between.

Prints of the greatest brilliance are produced from negatives which have been so correctly exposed and developed that they will print perfectly on normal paper.

Certain artificial aids to brilliance such as abnormal development of the negative or use of contrast paper are rarely satisfactory and seldom produce the proper illusion. These aids should be reserved for subjects which are extremely dull and low in brightness range.

One of the greatest deterrents to brilliance in prints is negative fog. In the printing process brilliance will be increased by the correct exposure and development of the paper. Extended development tends to increase the brilliance of the print, up to a certain point. Overexposure and underdevelopment of the paper will give exactly the opposite effect.

BROMIDE AND BROMINE. *Bromide* is a salt of hydrobromic acid, a compound of bromine with other elements.

Alkaline bromides like ammonium and potassium bromide are used in developing solutions as restrainers, to hold back the overly energetic action of the developer upon the exposed emulsion. Ammonium bromide is particularly useful in producing warm tones by development.

As restrainers the alkaline bromides are more effective in developers of low energy such as hydroquinone than with more

BROMIDE PAPERS AND BROMIDE ENLARGEMENTS

energetic developers like metol. The depression in density caused by introducing an alkaline bromide is, for any particular developing agent, approximately proportional to the logarithm of the bromide content. The restraining effect becomes less marked as the time of development is increased.

Alkaline bromides are useful for preventing fog during development. They thus enable development to be carried to a higher contrast.

Silver bromide is extremely sensitive to light and so, along with ammonium and other bromides, is used in the manufacture of photographic plates and papers.

Bromine is a non-metallic element which is not found in a free state in nature but combined with magnesium, potassium, or sodium. It is obtained as a deep orange-red liquid. It is extracted from sea water and also from certain salt deposits and is used to form bromides.

BROMIDE PAPERS AND BROMIDE ENLARGEMENTS

H. Lou Gibson

Eastman Kodak Company, Rochester, N. Y.

Enlarging has become one of the most interesting and indispensable parts of photography—and most of our enlarging is done on bromide papers. In Part I of this article you can become intimately acquainted with your enlarging papers—know their structure and characteristics. Here we are told about the manufacture of photographic papers and emulsions, the various surfaces and tints. Such subjects as density and brightness range, sensitometric curves, spectral sensitivity, and exposure scale are taken up. In Part II, the practical business of enlarging is discussed—and you will find out how to check equipment, make the projection, develop and fix the enlargement, choose the correct exposure and paper. The author also has a few words of wisdom on the subject of dodging, distortion, combination printing, mounting, and spotting.

See Also Beginner's Guide to Developing and Printing, Emulsions and Film Manufacture, Enlargers and Enlarging, Printing-Out Papers, Tone and Tone Scale

BROMIDE PAPERS PART I

THE PAINSTAKING work of the lens computer, the competence of the camera manufacturer, and the genius of the maker of

good negative materials are fruitful only if equal skill is applied to making a material for the final requirements—a photographic paper.

The following article deals mainly with the two most important aspects of photographic paper—structural and photographic characteristics. A knowledge of these subjects will enable the photographer to appreciate his working material and also to understand the handling of photographic paper. Such knowledge aids in the producing of fine prints just as a broad knowledge of the many types of wood aids a wood carver in working and finishing various grains.

THE STRUCTURE OF ENLARGING PAPERS

Enlarging papers are designed with definite physical characteristics to support and display a silver image and to carry it safely through processes that are decidedly arduous for paper to withstand. In addition to the paper support, there must be a liquid vehicle to carry the silver salts that yield the image, and there is usually a sub-coating to enhance image brilliance by preventing the silver salts from sinking into the stock.

The light-sensitive silver salts and their vehicle make up the photographic emulsion. This part of the paper is most interesting photographically and is dealt with first.

Emulsions. The light-sensitive crystals of the silver halide salts that are used in photography (bromide, chloride, and iodide of silver) must be held securely in an even layer during the various processes involved or they will escape or form large clumps. Yet they cannot function efficiently if held with a binder that is too stiff. Gelatin is the most suitable vehicle.

Gelatin. Gelatin is a protein substance extracted from the hides, hoofs, horns, and bones of certain animals. Only gelatin of the finest quality, extracted mainly from the hides of calves, can be used for photographic purposes. The extraction must be done at low temperatures and hydrolization (the breakdown of the gelatin into degradation products) must be prevented.

The properties of gelatin when competently utilized make it extremely valuable for emulsions. When dissolved in warm water it forms a clear fluid colloidal solution

(a hydrosol) in which the chemical reactions required to produce light-sensitive crystals can be completed and minutely controlled. The resultant crystals remain dispersed uniformly throughout the colloid. The

resulting "hydrogel" dries to a flexible and tough light-sensitive coating which permits and yet withstands the subsequent developing, rinsing, fixing, and washing processes required for producing the silver image. Such a substance is of particular value in making photographic papers which necessarily must resist sharp bending, prolonged soaking, and other somewhat rough treatments in production and in use.

Emulsion Making. This process involves the uniform precipitation of minute silver-halide crystals, throughout a crock of warm gelatin hydrosol. The process comes about from the reaction between incorporated alkali halide and added silver nitrate. The astounding variety of characteristics obtainable in the product of this apparently simple procedure comes from the control of a few variables. The sources of the gelatin, the concentrations of halide and gelatin, the choice of reagents, the rate of mixing the reagent, the acidity or alkalinity of the hydrosol, the choice of spectral sensitizing agents and of salts for contrast requirements, digestion or ripening times, the washing of residual salts, and the temperatures for each step—these variable are the notes upon which the masters of the emulsion departments ring the changes to produce and reproduce emulsions of almost any desired characteristics. Grain size, graininess, image tone, speed, spectral sensitivity, gamma infinity, and latitude are regulated to yield the required emulsion.

Types of Enlarging Papers. Enlarging paper coatings are prepared from silver bromide or silver bromide plus silver chloride emulsions. In each case a certain amount of silver iodide is often included. Silver bromide is sensitive to blue and ultraviolet, silver chloride to ultraviolet. Silver iodide also possesses and imparts a certain amount of green sensitivity to emulsions. Knowing that tungsten illumination is relatively weak in ultraviolet, one can readily see why a chloride paper is slow and why a bromide paper is fast.

As in the case of negative emulsions, it is possible to incorporate dye sensitizers in paper emulsions to extend the spectral sensitivity (Fig. 1). The application of such technic is confined chiefly to the manufac-

PAPER SENSITIVITIES AND SAFELIGHT TRANSMISSIONS

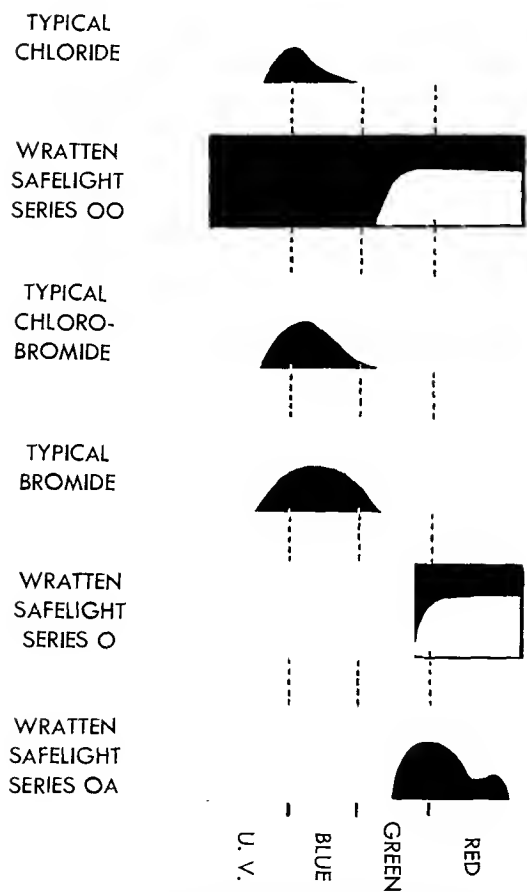


FIG. 1. PAPER SENSITIVITIES. This chart shows the varying sensitivities of various papers. Chloride paper, being less sensitive to greens, is slow; bromide, being sensitive to the greens somewhat and the blue to a great extent, is fast. This sensitivity is governed by the proportions of silver chloride and silver iodide in the emulsion. The chart also gives the safelights which can be used with each paper—a safelight being usable if its spectral curve does not overlap the spectral curve of the paper

emulsion thus made can be used on films, plates, and papers. Then before unevenness can occur in the coating, the emulsion can be chilled to a stiff gelatinous layer. The

BROMIDE PAPERS AND BROMIDE ENLARGEMENTS

ture of special papers such as certain modifications of contact printing papers, multiple contrast papers, photostat, and oscillograph recording papers.

Enlarging paper emulsions fall into the following self-explanatory classes and their speeds decrease generally, in the order that they are given: bromide, bromo-chloride (currently classed with chlorobromide), and chlorobromide. Contact printing papers are usually made from chloride emulsions, which are not fast enough for enlarging.

The speeds of good enlarging papers are compatible with the light intensities present in current enlargers. This also is true for a certain class of high grade papers designed for both enlarging and contact printing. The speed of papers in this class, of course, has to be such that exposures of controllable duration can be made on them in contact

printing and yet such that they are fast enough for enlarging requirements.

The ultimate practical difference between a bromide and a chlorobromide paper lies in the color of the image after development. Bromide enlarging papers are marked by the black tone of the final silver image. Chlorobromide enlarging papers are warm and tend toward brown tones. (However, all chlorobromide papers are not warm-toned for certain contact printing papers of this type are blue-black in image tone.)

These tone variations result chiefly from the different sizes of the silver halide crystals in the emulsions. In general, the smaller the grain size, the warmer is the image. Thus, the warmth of chlorobromide papers comes about because it is possible to precipitate extremely minute light-sensitive crystals in chlorobromide emulsions.



FIG. 2. SUBJECT CONTRAST. When a subject has great contrast—as has this one with its black shadows and its brilliant white sunglade—a paper is needed which can accommodate the extreme range. A full black silhouette would have been achieved if contrast paper had been used. As it is, normal paper served to give the backlighting effect, while still preserving a bit of detail and softness in the shadowed foreground

Photo, Charles Phelps Cushing

Contrasts of Papers. Photographic paper emulsions are usually made with a predetermined sensitometric curve slope. That is, correct development yields practically a single contrast. Prolonged development, unlike that in the case of negative materials, generally results only in an increase in overall density that could be obtained with longer exposure and normal development. The contrast of bromide papers, however, can be increased to a certain extent by prolonged development; that of chloride and chloro-bromide papers is not, in general, capable of such control.

Special emulsion coatings are available which can produce several contrasts from one paper. The papers are coated with a combination of two emulsions. One is a low contrast or "soft" emulsion and the other is contrasty (Fig. 2). The spectral sensitivities are such that one emulsion can be activated with blue light alone and the other with green light. By proportioning the total exposure time between partial exposures through blue and yellow filters (yellow filters transmit green) or by using single filters which pass various amounts of blue and green light, many contrasts within the two limits can be obtained.

Matting Ingredients in Emulsions. For a glossy and lustrous paper the emulsion is coated in the clear state. To produce semi-matte and matte surfaces various amounts of certain photographically inert substances are incorporated before coating. Rice starch (cooked or uncooked), fuller's earth, infusorial earth, and finely ground silicates all can be used as matting or gloss-reducing agents. Other surface or textural effects are usually applied to the sub-coating of the paper (baryta). There are, however, papers made with combined textural and matting agents in the emulsion. These incorporate such substances as coarsely ground silicates (or glass) and cellulose fibres in such forms as cotton flock.

Paper Stock. The chief requisite for a photographic paper stock is that it provide as permanent a picture as possible. Thus, the paper itself should be permanent, and it should be inert so that it does not affect the silver image. Such requirements can be met with a mat of pure cellulose fibres. To

realize that the first requirement is met, it is only necessary to recall the fact that ancient Egyptian papyrus documents are in existence today—the cellulose fibres of papyrus have endured the corrosion of centuries. Modern testing methods show that the second requirement, inertness, also can be met with pure fibres.

Fibres of flax and cotton have been in the past the chief raw materials for ordinary papers and for photographic papers. The new-grown fibres provided the purest and strongest material; sun-bleached rags formed an economical source. However, when paper became one of the important indicators of civilization, another source to meet the demand was found in the pulp of macerated and chemically treated logs.

At first a permanent paper could not be made from wood pulp because no means were available for removing impurities which destroyed strength and permanency. It was only after ten years of patient research by the Eastman Kodak Company and a cooperative producer of pulpwood that a modern method of making large quantities of photographic paper stock was developed. By carefully purifying the cellulose fibres from coniferous trees the raw materials for paper of the highest quality, embodying permanence and inertness, were obtained. The Eastman Kodak Company is the only manufacturer of photographic paper *base stock* in the United States.

That this wood pulp can now be used for photographic papers (Fig. 3) is fortunate, because cotton and linen rags which until only a few years ago were considered the sole source of good paper, are no longer available in large enough quantities, nor obtainable in a condition not seriously degraded and weakened by chemical bleaches. Purified wood pulp also has a great advantage over paper rags in that its purity can be assured, whereas rags from hundreds of unknown origins are almost certain to contain impurities that would contaminate the light-sensitive photographic emulsion coating.

Paper Making. To trace in detail the saga of a spruce tree from the axe to the photographic coating machine would require a volume. The picture can be only sketched

here. The felled logs are floated to mills where they face the first gauntlet of processing machines. De-barkers rip the unsuitable outer layers from the logs. Then modern machines, with maws more terrible than those of a host of fabled monsters, tear the wood to shreds. The ground wood is next chemically purified by cooking processes that remove natural resins, lignins, and pitches. These would cause oxidation and weaken the paper. Beaters reduce the purified wood to a finely divided pulp in preparation for the paper making machines.

A certain amount of sizing must necessarily be incorporated in purified pulp for photographic paper, to facilitate handling in enlarging sizes and to make it resistant to water and the alkaline and acid photographic processing baths. At the same time the paper must be flexible. Alum-precipitated resin and special sizes are used.

The next step is the formation of paper from the water-suspended fibres. This is accomplished in the continuous paper making machines. The milky liquid is flowed onto a wide continuously moving wire-screen belt. The solutions drain off through the fine mesh and leave the fibres to mat into a thin felted layer. After the screen has traveled a certain distance the layer is dry and tangible enough to be fed between wringing rollers (Fig. 4) and over hot drying drums.

Throughout the entire process meticulous care must be exercised to minimize and detect the invasion of impurities such as iron, copper, and dust. Tools must be kept sharp and machinery kept in good repair. Photographic paper plants are completely air conditioned. Rigid inspections are maintained at each stage. Such care safeguards the stability, permanence, and quality of the silver image.

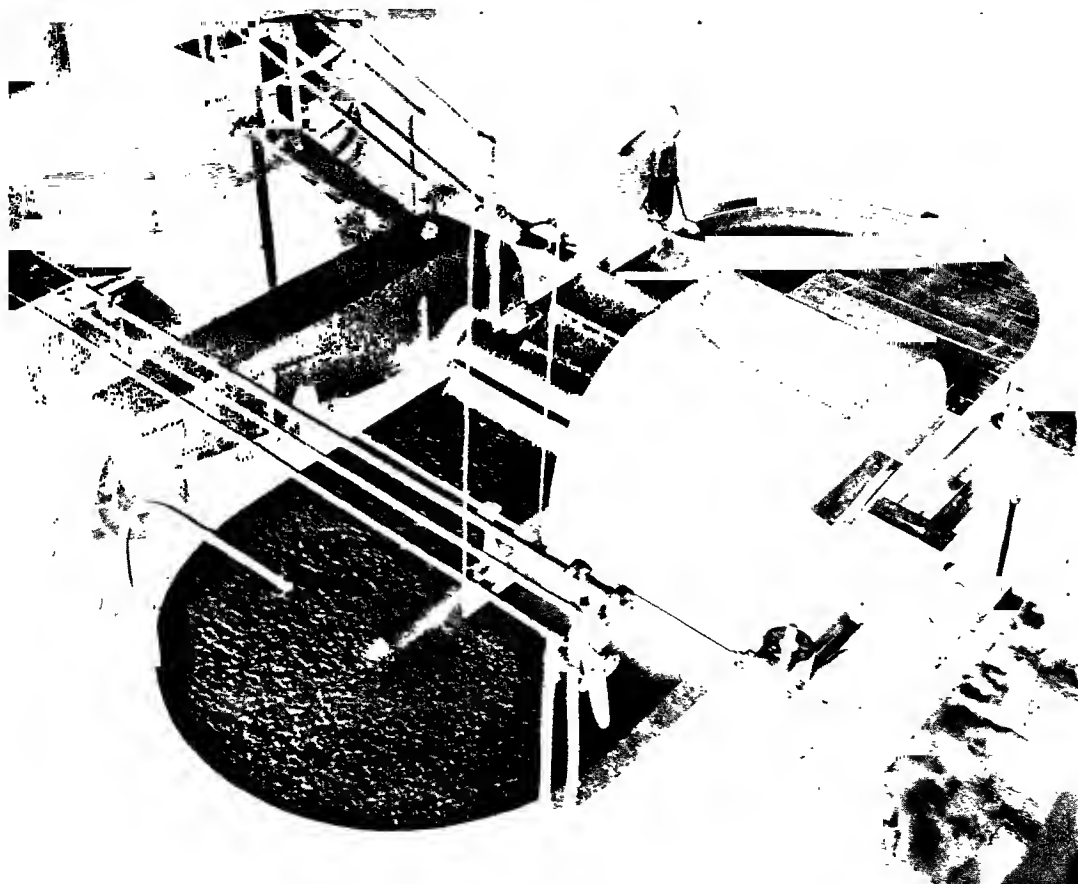


FIG. 3. PULP BEATER. Photographic paper stock must be extra pure and free of foreign ingredients. A special paper base of wood pulp is shown being ground. Later it will be put through a paper making machine, where a wire screen belt transforms the milky liquid to a fibrous substance

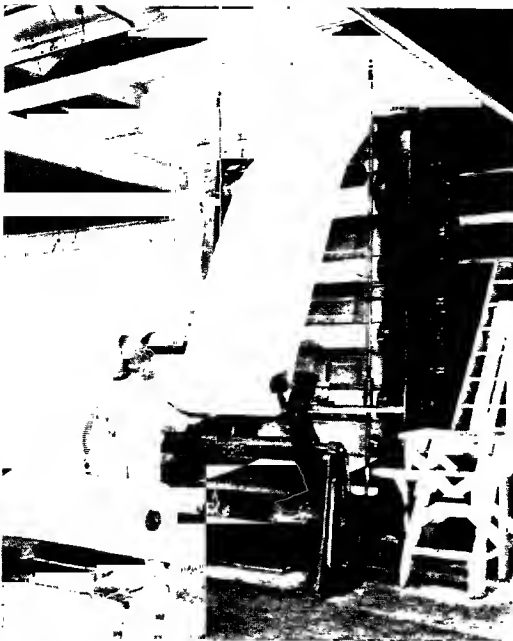


FIG. 4. SUPERCALENDER FOR PHOTO PAPER. When the rough paper is dried, it is fed through these rollers so that evenness and smoothness are assured. Notice the footage counter just below the worker's right hand

Surfaces and Tints. One more stratum is required in most photographic papers—baryta. This layer is even more modest in announcing its presence than the paper stock. Yet on it depend to some extent the tint and the surface of the print.

Baryta coating consists of a mixture of barium sulfate, tinting pigments, a flexible vehicle, and suitable adhesives for providing smooth, firmly coated emulsion layers. The surface characteristics of the papers can be embossed by heavy patterned rollers into the baryta coating. A wide variety of surfaces can be made—from glossy through smooth and rough to textured and stippled surfaces. Of course, the character of the paper itself also has a bearing on surface and tint. (See also articles on *Baryta* and *Photographic Papers*.)

Coating. Having produced an emulsion and a coated paper base of high quality, the manufacturer of photographic paper is still faced with the problem of getting them together before he can market the result of his efforts. Here again there is room for ingenuity and skill. Anyone who has repainted a barn door or his wife's bureau will appreciate some of the difficulties encountered in preventing a heavy coat from running.

The styles of emulsion coating machines vary with the manufacturers. Very little data is available on their design. The general principles of the process are the same.

The paper, 36 to 42 inches in width, is taken off a supply spool and threaded over tension rollers so that it will hug a coating roller evenly and be tight enough to prevent the emulsion from spilling to the back. The coating roller either carries the paper through a trough of warm emulsion or brings it into proximity with a doctor roller. The latter dips into the emulsion and carries it around to the paper. The faster the doctor roller turns (contradirectional to the paper motion) and the closer it is to the paper the thicker will be the emulsion coating.

After the paper leaves the coating roller it is carried for a straight run of a few feet to give the emulsion a chance to even itself out.

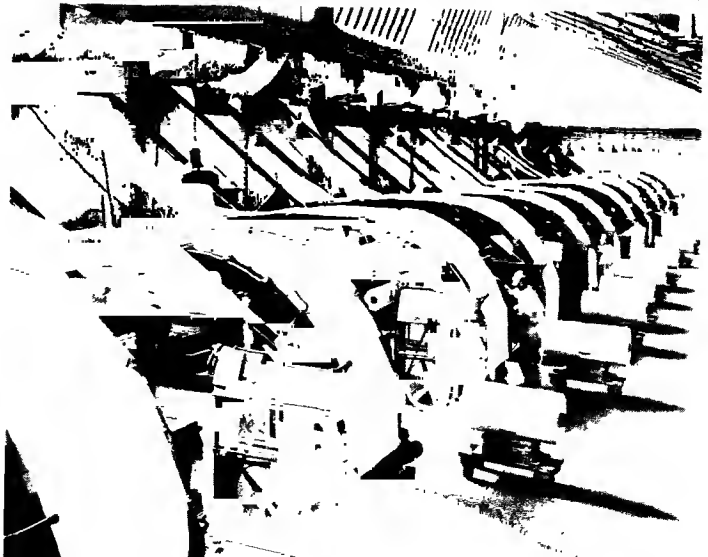


FIG. 5. AFTER THE BARYTA COATING. When the baryta layer has been applied, the paper is draped in festoons, and passed through a drying alley. Here the festoons are shown at the left, as they emerge, ready for rolling

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This "run" must not be too long or the emulsion itself will start to run. The next phase involves chilling the coating to form a stiff layer that is to remain set during drying. This is done in either of two ways—with cold air or with chilling drums.

After the chilling operation the paper is usually festooned in long narrow catenaries over wooden "sticks" that travel on endless chains (Fig. 5). In this manner the paper is continuously carried through a long drying tunnel to the final take-up roller. The dry-



FIG. 6. PAPER STORAGE. This base paper is stored until ready for sensitizing. After sensitized emulsions have been applied, work must, of course, be carried in the dark or under safelights

ing tunnel, which assumes the aspects of a paper hanger's nightmare, is conditioned with air of the right temperature and humidity to dry safely hundreds of yards of festooned paper.

Most papers are coated finally with a top layer of pure hard gelatin to protect the sensitive emulsion from abrasions that might damage it or produce developable streaks. This coating is applied in a manner similar to that just described.

The finished rolls of paper are stored in air conditioned vaults until required for cutting into packaged photographic paper (Fig. 6).

Final Operations. Cutting photographic paper is a procedure which requires chiefly an efficient layout of cuts to be made with a giant knife or guillotine. Large rectangular pieces are cut from the roll and several dozens are piled upon the platform of the guillotine. Cuts are taken through the pile, each one yielding a pile of sheets of a given size. Piles of different sizes are usually made with successive cuts so that it is possible to utilize all of the original sheets without waste.

Finally the sheets of paper are counted and packaged for delivery—contingent upon a favorable report from the inspection department.

Each batch of paper, after successfully passing intermediate inspections, now undergoes a final series of tests. Evenness of coating is checked by uniformly flashing a sheet with an exposure that yields a gray upon development. Speed is checked and gradation tested with standard negatives.

PHOTOGRAPHIC CHARACTERISTICS

The average photographer has a working knowledge of the photographic characteristics of enlarging papers. He has learned to choose the right paper to suit the contrast of his negatives just as experience has taught him that buttering his bread with a broadaxe would be strikingly incongruous or that attacking a forest with a butterknife would be somewhat futile. There are, however, the finer points to handling a butterknife or swinging a broadaxe.

Tone Reproduction. What does a good photographic print accomplish? If we neglect the aspect of color we can say that

it gives the observer the same impression of a scene, person, or object that the original gave the photographer (Fig. 7). Since seeing the original is possible only by virtue of the varying intensities of the light reflected from its component areas, then a photograph would seem to require the same reflection variations.

This is often impossible because the maximum *useful* range of reflecting power, from black shadow to clear highlight (print brightness range) in a lustre or glossy print is about 1 to 36*, whereas many scenes present a range much greater than this. That such scenes can be photographed successfully is due to the fortunate subjective accommodation that the eye can make when it views a print.

The theory of tone reproduction is a complex one; even today there are many aspects still to be analyzed. The following discussion is intended to give a brief outline of the general considerations.

Brightness Range. There are three main problems involving scene brightness ranges represented on the photographic print. The first entails choosing an original with a brightness range that can be encompassed by the paper. This is easy to do in still life subjects and in portraiture, for here the amount of light reflected by the darkest and the brightest parts of the subject can be controlled by the photographer in illuminating the subject. (Specular reflections such as catch lights in the eyes can be disregarded.) The shaded flesh under the chin in a portrait can be lighted so that it is about $\frac{1}{4}$ as bright as the cheek. Then in the print this shadow can be printed 4 times darker than the cheek. A good print can result without appreciably changing the reflection characteristics in transferring them from subject to image as long as the total range lies within the scope of the materials used.

The second problem deals with a subject in which the tone range is just within that which the paper can accommodate, and yet the range embodies no sharp contrast, so that a great deal of black or white is not desirable on the print. Such subjects are usually termed flat-lighted. Such scenes, when printed on a paper of suitable contrast, can

*This ratio in a matte print is about 1 to 12.

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be photographically represented without the necessity of considerable brightness compromises in shadow and highlight detail.

The third situation presents strong contrasts as well as a long brightness range. It can be exemplified by a beach scene. The sun shines almost into the camera and makes brilliant highlights on the water and bright patches on the sand. The sand is of a light tone; the skin of a girl standing in the water is a middle tone; the water is moderately dark. The young lady is wearing a dark bathing suit and casts a very dark shadow on the water. This scene has a brightness range that is not possible to portray photographically without making compromises. Some sacrifice in brightness rendition at the extreme ends of the range is necessary whereas the middle tones, that in this case

embrace the object of interest, should be printed to a suitable contrast and density for yielding pleasing representation.

When such scenes as the latter are printed, dodging (described in Part II) may be resorted to. In the above scene, it might be necessary to give the bathing suit less exposure ("hold it back") than the rest of the scene in order to show roundness and detail. The bright patches on the sand might have to be given more exposure ("print them in") so that the texture of the beach is not lost.

Throughout this discussion the aspect of color has been neglected and the function of the negative omitted. See the articles on Color Photography and on Negatives for these discussions.

A more tangible property of enlarging papers is contrast, with which the photog-



FIG. 7. TONE VARIATION. This is a photograph of middle tones—the sky is neither very black or white, the wheat fields and the shocks are differentiated only by very subtle gradations. For a shot such as this, great care must be taken to choose the right grade of paper. Control during enlarging may also be necessary—to darken the sky and keep the nearby shocks light enough to show detail. Photo taken on a farm in Earl Park, Indiana

Photo, J. C. Allen

THE COMPLETE PHOTOGRAPHER

rapher is especially concerned. Contrast involves two factors: density range and exposure scale.

Density Range. This is the range of reflection densities which the paper will produce, from clear unexposed areas to the deepest black. Since the print is viewed by reflected light, the density in the highlights is practically that of the clear paper, while the density of the deepest possible shadows (full black) is limited by the light reflected from the surface of the developed silver particles and the gelatin. The density range varies also with the surface texture of the paper, and to a lesser extent with the emulsion type.

The maximum density of glossy papers is about 1.70 in an arbitrary range of 0 to 2. For semi-matte, fine grain, and lustre surfaces, the value is about 1.50. The matte-surface papers have maximum density values between 1.30 and 1.20. Density range affects visual contrast of a print. For example, if the same negative be printed on both glossy and matte papers, chosen to have the same exposure scale, the glossy print appears more contrasty. Thus, the higher the density range of photographic paper—other things being equal—the more contrasty is the appearance of the print.

Exposure Scale. This property must not be confused with the speed or exposure time required. It relates to the range of light intensities required to produce a print having the full range of useful tones from white to

black. For example, in the case of a paper of low contrast ("soft"), if a light intensity of 1 produces a just noticeable effect, then a light intensity 30 times as great might be required to produce a full black. The values from which the limits of the exposure scale can be determined are most usefully based on gradient measurements on the characteristic curves. The gradient of a curve is a measure which indicates the slope (or contrast of the material) at a given point on the curve. The exposure scale thus defined is often stated as indicating the exposure interval between one point on the low or high-light end of the curve where the gradient is 0.2 (lower gradients than this are not useful for rendering detail) and another point on the shoulder or shadow end of the curve where the gradient is again 0.2. This range approaches in most cases the range of light intensities transmitted by the significant parts of the appropriate negative. Exposure scale, in contrast to density range, is essentially the same for different surfaces of the same contrast grade of a given paper.

The essential difference between contrast grades of the same paper is one of exposure scale. The higher the contrast of the paper, the lower the exposure scale. Logarithmic values of paper exposure scales are comparable to the density range in negatives and are often used in certain enlarging exposure and contrast meters or calculators. Contrast grades are again discussed after sensitometric curves have been treated.

Sensitometric Curves. The physical and chemical forces that produce the photographic image seem to have one very human aspect. When they start building image density on a print, they need to get "warmed up" to the work; results are slow in accruing at first. Then they "hit their stride" and work efficiently until a point is reached in which they slow down.

The exposing light, like Tom Sawyer painting the fence, does a small initial

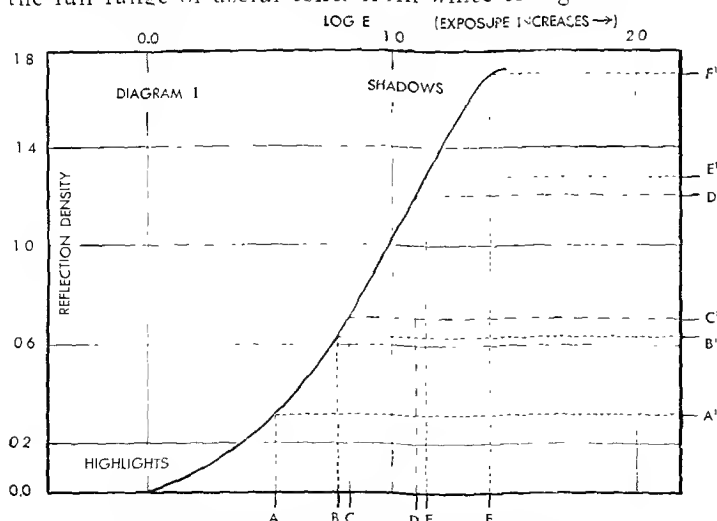


FIG. 8. SENSITOMETRIC CURVE. This typical sensitometric or characteristic curve is fully discussed in the text

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part of the job; then developing agents are set to work to build up the image. The more persuasion (in the form of exposure) that the light can apply, the more useful work is obtained from the developer. This goes on until a point is reached where the exposure has been sufficient to yield a black. Greater exposures, which yield more silver on the print like a second coat of paint on a fence, result only in small additional visual effects. As more and more silver is deposited, practically no darkening occurs, just as four or five coats of black paint would not result in a much blacker fence.

The most convenient way to show these effects is by means of a sensitometric curve.

The sensitometric curve tells in one graphical line characteristics about a paper that would require hundreds of words to describe fully. The fundamental concepts are dealt with below.

The first requirement for obtaining a sensitometric curve is a test strip made on the paper to be examined. This is done in a sensitometer, which gives the paper a series of exposures that varies logarithmically* along the strip over an exposure range somewhat greater than that encountered in practice when printing from negatives. Reflection densities or degrees of blackness are measured at different points along the strip, and the results are plotted on a graph. This yields the sensitometric curve shown in Figure 8 (Diagram 1).

If the paper were such that equal logarithmic changes in exposure produced equal changes in print density, then the sensitometric curve shown would be a straight line. This is not the case—the curved response is the result. It will be seen that the print density difference (A' to B') between exposures A and B is less than the difference (C'

to D') between exposures C and D . The difference E' to F' is also less than C' to D' . This differential response, taken throughout the exposure range, results in the rendering shown by the sensitometric curve.

A certain definite amount of exposure is required to produce the first noticeable gray.

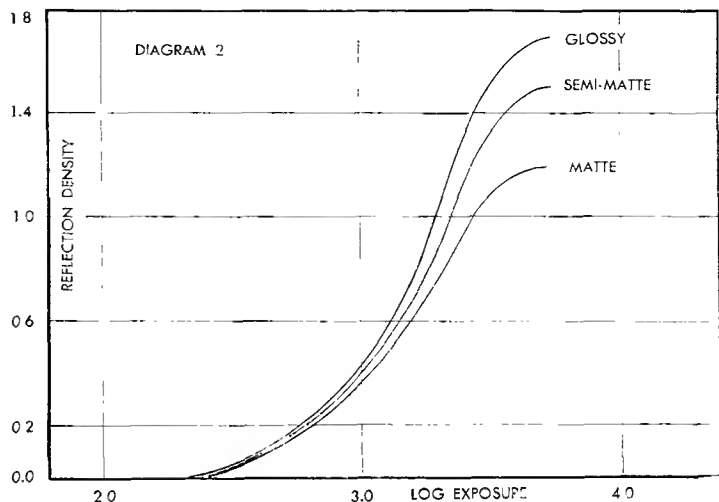


FIG. 9. PAPER SURFACE CURVES. This shows the effect of paper surfaces upon the shape of the sensitometric curve. Notice that the glossy curve is steeper and longer, indicating a greater tone gradation. With 2 as an arbitrary and theoretical top in black density, the 1.7 of glossy is excellent

Then, as the exposure increases (shown logarithmically increasing horizontally to the right), the density increases (shown increasing vertically upwards). The growth of density from exposure is slow at first, then it accelerates, and finally it slows up as a maximum useful density is approached. At the latter point further increase in exposure results in only a slight growth in density that is not useful in practice. This is indicated by the levelling off of the curve.

Effects of Surface. So much for the response aspects of the sensitometric curve. There are other things that the curve tells. Figure 9 (Diagram 2) shows the curves for papers of different surface characteristics though with the same emulsion. It will be seen that the glossy paper produces a maximum black density of 1.7, which means that black reflects 1/50 of the brightness of the white. The matte paper, on the other hand, has a maximum density of less than 1.2 and thus reflects about 1/15 of the white brightness. Thus it is evident that a scene with

* "Logarithmically" is a mathematical term. Logarithmic values are often used in photography rather than ordinary arithmetic ones because the results approximate the visual effect more closely.

strong contrast is most faithfully reproduced on a glossy surface and that subjects with a short brightness scale (such as a high key portrait) can be printed effectively on a matte paper.

matte or semi-matte surface it is quite likely that (at the expense of highlight and shadow detail) a grade of higher contrast than that chosen for the glossy print would have to be used to obtain the results desired.

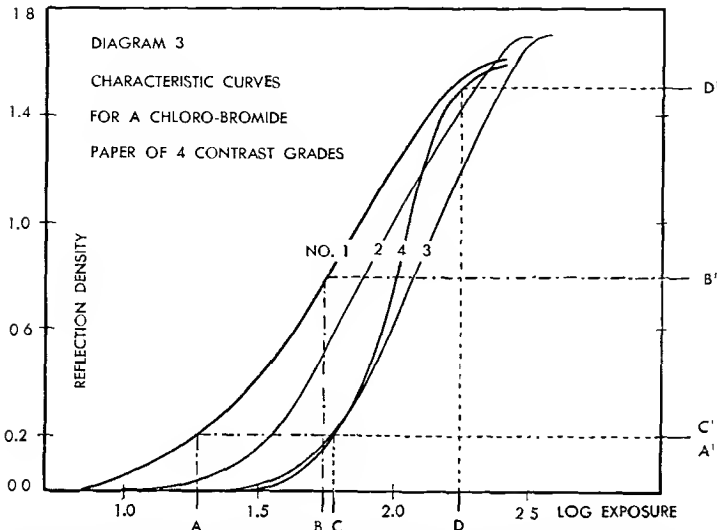


FIG. 10. SENSITOMETRIC CURVES FOR CHLOROBROMIDE. The sensitometric curves for the chloride, bromide, and chlorobromide paper all vary. These are the chlorobromide curves explained in the text

Contrast Grades. The sensitometric curves for the four grades of a chloro-bromide paper are shown in Figure 10 (Diagram 3). It will be noticed that the slopes of the curves are not the same, 4 being steeper than 1. The comparison of 1 and 4 shows that equal exposure ranges—A to B, C to D—yield unequal density ranges—A' to B', C' to D'. Thus, a good print from a portrait negative with a modeling density range that happens to be from A to B might be found to possess shadows 4 times darker than the highlights (a reflection density difference of 0.6). The print was, of course, made on contrast grade 1, for that contrast grade shows a density change of 0.6 for the exposure change AB. The use of grade 4 would yield a density difference of 1.3 (20 to 1), resulting from AB. This would look harsh or contrasty.

The maximum useful black that a paper can yield also has some bearing upon the contrast grade chosen. For example, a brilliant snow scene with strong contrasts would look best on a lustrous paper with a long tone range such as a glossy or silk-textured one. However, should it be necessary to use a

bromide is further toward the blue. A chlorobromide emulsion possesses aspects of both components of the mixture. Dye sensitizing introduces a broader sensitivity.

It is of course necessary when handling photographic papers to use a safelight which passes the maximum amount of "safe" light. The color of the transmitted light should be such that the contrast and density of prints can be judged easily during processing.

Figure 1 shows the wedge spectrograms of the four types of emulsions mentioned. Superimposed on the spectrograms are the transmission curves for suitable safelights.

An extremely practical aspect of the spectral sensitivity of papers is the variation of enlarger speed with the voltage changes in the lamp recommended for the enlarger. When an incandescent lamp is burned below its rated voltage, it emits not only less total illumination, but the proportion of blue-violet radiation is greatly reduced. This results in a lower photographic effectiveness often interpreted as lower paper sensitivity. In some cases, a drop of 5 volts may require as much as 30% increase over normal expo-

The sensitometric curve reveals other characteristics of a paper such as speed and gradient. However, the former is easily determined in practice or from manufacturer's data and the latter is chiefly of theoretical interest. The mathematical theory behind rating the contrasts of papers involves the average gradient of the curve and the density range of the paper. (See also articles on *Gradient* and on *Tone Reproduction*.)

Spectral Sensitivity. As stated before the maximum sensitivity of silver chloride is in the violet and ultra-violet regions of the spectrum while that of silver

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sure time. Many photographers measure or obtain from their local power company the exact voltage of their lines and then use a lamp of the next lower voltage rating (though of the same wattage) to be sure that printing speed is maintained as high as possible in spite of line voltage fluctuations.

Armed with a general knowledge of what a good photographic enlarging paper is and how it works the photographer is well equipped to study the methods of obtaining enlargements of the highest quality and maximum interest.

BROMIDE ENLARGEMENTS: PART II

ACCOMPLISHMENT in choosing or arranging a subject, expertness in exposing a negative, and care in developing it are valuable only if the photographer is proficient at making a print.

There are two aspects of making enlargements of the best quality. The first involves the careful and intelligent handling of apparatus, materials, and processing solutions. The second involves judgment in choosing the paper grade, surface, and tint. Careful handling can be learned in a few darkroom sessions; judgment can be acquired only with experience.

For the early photographers, back in the days when contact printing was the only method of making prints, large negatives and large prints were standard. Early negatives were a bulky nuisance but you had to put up with them if you wanted attractive pictures. That is no longer true. Today, negatives are smaller, yet their capabilities for yielding pictures of excellent quality are undiminished.

Enlarging has become one of the most important phases of photography. It has made practical the use of small negatives and hence compact cameras; without it photography would not be far advanced from the days when a donkey with a strong back was the handiest photographic accessory a man could possess. Attendant upon this convenience has come the necessity of mastering the enlarging technic. That proficiency in this technic is not difficult to attain is vouched for by the extreme popularity of enlarging.

The requirements for enlarging are: an enlarger, a paper board, a good, correctly exposed negative, processing solutions, and enlarging paper (Fig. 11). The structure and functions of enlargers and the making of good negatives are dealt with elsewhere in this publication (see article on *Enlargers and Enlarging*). For now let us assume that a paper suitable to the negative has been chosen. Making that choice—Judgment in Enlarging—is outlined on page 515.

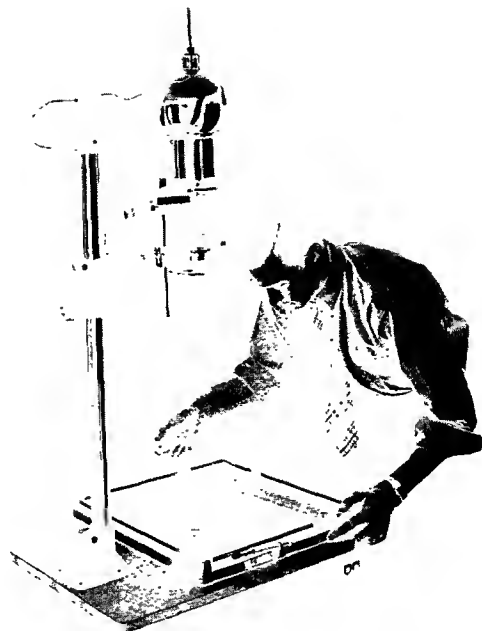


FIG. 11. PROJECTION EQUIPMENT. Shown here is a new type of precision enlarger set on an adjustable shaft. The worker is also using the framing easel and a hand switch—both helpful accessories

CHECKING THE EQUIPMENT

An enlargement of good quality, with sparkling highlights and clean shadows, stands out in a group of mediocre prints like the concentrated purity of a diamond in a handful of broken pop bottles. Probably the most common degrader of print quality is a faint muddy gray veiling the entire print. Omitting contrast considerations for the present, let's study the other causes for a lack of quality in a print.

Is the darkroom really dark? This can be checked by leaving a piece of fast enlarging paper exposed in the supposed darkness for

fifteen minutes. A few coins should be laid on the emulsion surface for the duration of the test. The safelight should not be on. If pale discs show on the paper after it has been fully developed then the darkroom is not safe. If that is the case, chinks should be stopped up with putty or plaster, and the entrance and ventilation outlets should be light-tight. (See article on *Darkroom Planning and Arrangement*.)

The next cause of fogging that sometimes needs investigation is the safelight. A test



FIG. 12. FOCUSING DEVICE. By looking at the projected image as it is reflected by prisms on the groundglass of this accessory, accurate focus can be obtained. Care must be taken, however, to set the focusing device on a piece of paper equivalent in thickness to the paper which will be used, as fine differences in distance may be important

of its suitability and condition can be performed in a similar manner to the above, only this time the safelight should be turned on and the paper should be placed at the closest working distance to the safelight. The time of the test should be about that which a piece of paper normally experiences between package and fixing bath. If pale discs now show after the paper has been developed in the dark, the following details should be investigated. The safelight filter, the lamp, and the working distance should be the ones recommended by the paper manufacturer (see Fig. 1); the safelight

housing and the filter should be in good condition.

Another cause of foginess, often unsuspected, is a dirty lens. Omnipresent dust collects on the upper surface of the lens in a vertical enlarger; smoke and steam (especially in basement darkrooms) seem to be particularly attracted to the lower surface; and fingerprints are often left inadvertently on the surfaces. A little dirt can convert a \$50 lens into a dirty \$5 lens. Hence a dust cover for the enlarger and a cap for the lens are advisable accessories. If the lens becomes dirty—a detail that can be discovered easily by looking at the lighted illumination system through the lens—then it should be cleaned carefully with lens cleaning paper and fluid.

The most common cause of foginess is stray light that leaks around the entire negative or around the part that is being enlarged. A good enlarger is equipped with adjustable or other suitable masking devices to prevent this occurrence. A mask can be cut from black paper to perform this important function in enlargers not so equipped.

Enlarger surroundings sometimes cause fog and if a stray light mask is not used, they often add further to the general degradation. Light walls in the proximity of the enlarger should be avoided as they might cause trouble: light clothing on the photographer is occasionally the cause of fog.

The photographer who gets badly fogged prints is fortunate. The lack of print quality is easily observed and the photographer's reputation is saved by the waste can. It is the slight foginess, which so often escapes detection, that must be avoided. If light foginess is noticed, the negative or the paper is often wrongly blamed. If it is not noticed the print goes on exhibition. Then the photographer is rightly blamed by judges or critics.

CARE IN PROJECTING AND PRINTING

Focusing the Image. Focusing should be done with the lens wide open. Such a procedure has two advantages: first, a bright image is more easily seen and second, the subsequent stopping down of the lens possible for the exposure yields a greater depth of focus and thus provides a safety factor for

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FIG. 13. TEST STRIP. The whole piece was exposed for 2 seconds, then the lightest step was covered. Exposure was continued for 2 more seconds and the next step covered. Subsequent coverings were made after 4, 8, and 16 seconds. These steps thus represent exposures as follows (from right to left): 2, 4, 8, 16, 32 seconds. The 8 second or middle exposure is the correct one

slight errors in focusing. In some homemade enlargers stopping down should not be carried too far or blurred outlines of grain or scratches in the groundglass diffusing screen or a "hot spot" from the lamp might be superimposed over the image on the print.

As points of reference for focusing, contrasty details in the negative are best. In a portrait, the catch lights of the eyes are ideal (provided they are sharp on the negative). Twigs in a landscape and the sharp lines that occur somewhere in most other negatives can be chosen. There are various devices available for aiding the photographer in focusing his enlargements (Fig. 12.) They are particularly valuable in printing from dense negatives. It is often advisable to substitute a thin negative or a test negative for a dense negative in focusing.

A fault in definition that should be guarded against is poor corner definition. This is caused by inadequate covering power on the part of the lens and is most common in homemade enlargers which often are equipped with lenses whose focal lengths are

too short for the negatives used. A poor enlarger lens frustrates a good camera lens. The remedy is obvious. *The focal length of the enlarging lens should be approximately the diagonal of the largest negative with which it is to be used.*

Finally, care must be taken that the enlarger is not jarred during the exposure, for vibration will cause blurred definition.

Diffusion Discs. Since sharpness is so desirable the photographer might ask whether diffusion with a diffusion disc has value. Diffused images are not entirely out of focus, in fact the image should be focused sharply before a diffusion disc is used. A diffusion disc superimposes sharp and out-of-focus images. An exposure can be made with the disc in place for only part of the time. Thus, by using a diffusion disc, the photographer can use at will just enough diffusion to subdue fussy detail in a print. This is chiefly useful in printing large heads and other pictures in which masses are the main pictorial interest.

Other means of diffusion can be employed, such as wrinkled transparent tissues and also

black chiffon. However, with these there is a likelihood of producing all-over fog, less image contrast, and an increased exposure time.

Determining Exposures. In the art of making exposures it is hard to decide where skill ends and judgment begins.

The most common way to arrive at the correct exposure is to make a "test strip" (Fig. 13). After the enlarger has been adjusted for making an enlargement, a narrow strip of the paper to be used should be placed within the projected image area so as to include the most important parts of the picture. Successive areas of the test strip are given progressively increasing (for example 2, 4, 8, 16, 32 seconds) exposures by intercepting the light beam close to the test strip with a sheet of black photographic paper moved along the strip with the desired steps in exposure time. The exposed strip is given the full recommended development. Correct exposure can then be visually determined by judging the several areas of different density that appear on the test exposure print.

A convenient semi-automatic way of making a test exposure print is to use a print scale, of which there are several on the market. This accessory is a circle consisting of 10 wedge-shaped segments of varying degrees of transparency, each segment being marked with a number. Place the print scale over the sensitized paper on the easel

and, with the negative in the enlarger, expose for 1 minute. Thus the image of the negative is projected onto the paper, but *through* the modulated scale. After development, the correct exposure is indicated by the number of the correctly exposed segment. This may be used for contact prints, too.

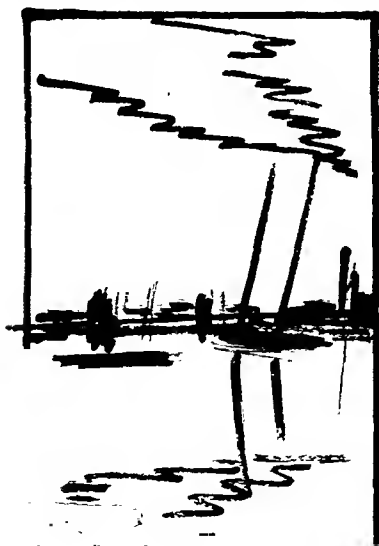
Methods and apparatus have been worked out for integrating the light transmitted by a negative by means of an exposure meter. Exposures for most negatives are arrived at in this manner very quickly. Various other photometric methods, utilizing homemade and manufactured photometers, can be employed to aid in determining print exposures. These may be used to advantage by those who are experienced in their use and familiar with their principles and limitations.

When changing magnifications the photographer should allow for the reduced light intensities concomitant with high magnifications. Calculators are available for figuring the changes required. The following formula can be applied to most diffuse or semi-diffuse enlargers.

$$\frac{E_1}{E_2} = \frac{(M_1 + 1)^2}{(M_2 + 1)^2}$$

where E_1 and E_2 are the exposures required at the magnifications M_1 and M_2 . This formula should be applied when the correct exposure is known at a given magnification.

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . HARBOR SCENE

The picture *Harbor Scene* deals with the justly popular photographic materials of water, sunlight, reflections, and clouds. The popularity of such picture motifs is, however, no guarantee of their successful rendering. To achieve such a fortunate balance between the necessary underexposure of the sky and at the same time retain some detail in the land and ships bespeaks an expert maker of negatives. A great deal can be done to strengthen this balance during projection printing. But, remember the old saying: "You cannot print what is not in the negative." Notice how the maker of this picture carefully bided his time until the sun was just sufficiently veiled by the long wisp of cloud. At this precise moment he tripped the shutter. Had he waited but a few seconds the sun would have emerged in its full brilliance and our delightful picture would have been impossible. To point the camera against such light requires the touch of a master!

While this writer realizes the importance of the bit of shore line in the lower left of the picture, he, at the same time, would be still happier if the horizon of the picture did not cut the picture almost in half. Whether by lowering the camera position this lowering of the horizon could be accomplished, is impossible to say without knowing the condition of the terrain. After all, this is but one of those unproven laws of composition, and at times an expert may go counter to any and all these rules and still come up with an interesting and beautiful picture. I think *Harbor Scene* is one of these.

Konrad Cramer



HARBOR SCENE

ALBERT A. GROBE

DATA: 6 x 6 Rolleiflex, Tessar f/3.5 lens, medium fast pan film, 1/25 second, f/5.6, 2x yellow filter



DOORWAY—SAN JUAN CAPISTRANO MISSION

WILLIAM MORTENSEN

This pictorial photograph is a bromoil transfer made from a 35mm negative. The transfer process, a notably facile one when control is desired (see article on Bromoil and Transfer), has here been used with considerable restraint and beauty. See *Control in Photography* by William Mortensen



FRAGMENT

WILLIAM MORTENSEN

This nude photograph was made from a miniature camera negative by the bromoil transfer process. Here a strong pyramidal pose makes for excellent composition—and the bromoil control gives excellent texture. A difficult subject handled well. See *Control in Photography, Bromoil, Nude Photography*



AERIAL PHOTOGRAPHY—BOSTON

U. S. ARMY AIR CORPS

This aerial photo was made by the U. S. Coast and Geodetic Survey from 6900 feet, with a 9-lens camera. It shows Boston Harbor, scaled 1:10,000. See Aerial Photography

(Continued from page preceding insert)

In changing exposures, when altering the density of successive prints for arriving at the correct exposure, a factor of at least $1\frac{1}{2}$ should be used by the photographer if appreciable differences are to be obtained. Beginners are often unaware of this and in exasperation, after ineffectively trying to improve print density by varying the exposures in small amounts, almost reach the point of suspecting a malign influence at work and then give up in disgust. They find, upon attaining proficiency in print making, that the only darkroom pixies are lack of knowledge and carelessness.

CARE IN PROCESSING

Development. The favorite haunt of darkroom pixies is in the developer tray. Correct processing is vital to quality and is best secured by following the manufacturer's recommendations for each paper. Formulas for a sufficient variety of effects are usually included with each paper. Recommended formulas are based on exhaustive research, on the many factors which affect quality, and on convenience and economy. The developer formula, its dilution, and recommended time and temperature are not dogmas; they are essentials.

A most common degrader of quality is underdevelopment. There is a human tendency to pull a rapidly darkening, overexposed print out of the developer tray before development is completed. The impulse must be curbed, for if a print is not fully developed, the resultant image is poor in tone, lacking in contrast, and it probably will be mottled and streaky from uneven development. Exposures should be carefully timed to suit the correct development.

Overdevelopment or lengthy development in an overworked or weakened solution also should be avoided for this is likely to cause yellow stain due to developer oxidation products deposited in the emulsion. Oxidation may also result from other causes, such as exposing the developing print to air or using an exhausted fixing bath. Processing stains even in slight degrees degrade print quality. Of course, bad cases of staining are noticed immediately and the prints so affected discarded. Mild cases of stain

usually become evident only after the print is dried. It is psychologically harder to discard a dry print than a wet one so that care pays dividends.

The above discussion is not meant to imply that there is no latitude or free will in developing. A certain amount of tone control is possible by varying the development times of chloro-bromide and chloride enlarging papers. Thus if these papers are lightly exposed and developed for a long time the image becomes cold, while if they are heavily exposed and developed for a short time the image is reddish or brown-black. The incipient image is reddish at first and then as more halide crystals are developed they tend to grow in size somewhat. That is, they grow larger from the depositing of more silver on the original grains and from the super-depositing of several grains. The increased size of the resulting silver particles makes the image blacker. Developers that act slowly and agents like potassium bromide that etch silver halides produce warm tones because they result in small sized silver particles.

The image tones of bromide and fast chloride papers should not be controlled by development; the size of the crystals are sufficient for a gray deposit even as first deposited. *These papers should always be given the full development recommended by the manufacturer* if richness in the print is desired. The effect of underdevelopment is simply to produce a weak gray instead of black. The contrast of bromide papers can be increased somewhat by prolonged development and slight underexposure. The resulting tone change is usually small.

To allow proper print agitation and handling convenience the developing tray should be somewhat larger than the print. Good trays are made with this need in mind. For example, an 8 x 10-inch tray should measure about 9 x 11 inches. The exposed print is slipped edgewise and face up into the developer solution so that it is covered quickly and evenly. During development, the solution should be agitated by rocking the tray or by keeping the print in motion. The print must be kept completely immersed during development or exposed parts will be underdeveloped, if not stained.

Acid Rinse Bath. After development, the print should be immersed in an acid rinse bath, which neutralizes the developer and curtails its action. Prints should be left for at least 5 seconds in the rinse bath between development and fixation. This minimizes the risk of stains and uneven development and prolongs the acidity and life of the fixing bath. If the rinse bath is not used, the alkaline developer retained in the gelatin and paper fibers of the print neutralizes the acid in the fixing bath. Prints fixed in such a bath are not permanent and eventually may turn brown or yellow.

Another human tendency that requires curbing occurs at this stage. The prints are often examined close to the safelight before they are immersed in the fixing bath. The latter procedure allows the possibility for stains due to oxidation and for fogging from residual developer and unsafe proximity to the safelight.

Fixing. Prints should be transferred from stop to hypo fixing baths quickly. Several prints can be placed in the fixer but they should be separated, agitated, and kept well immersed so that undeveloped silver halides and developer residues can be quickly and evenly dissolved out. A fresh fixing bath should be used, and the prints fixed for 10 to 15 minutes.

Prolonged fixing should be avoided, particularly with warm toned prints, because of the tendency of the bath to bleach the image and change its tone. A bath with a certain amount of hardening ingredients is desirable to toughen or tan the gelatin and make the print durable.

For greatest permanence, after the normal fixing, prints should be placed for 5 minutes in a fresh fixing bath before washing.

Washing. To prevent fading and discoloration, the hypo must be removed from the finished prints. Prints must be washed for at least an hour and preferably longer in a tray in which is running a deflected stream of water sufficient to change the water in the tray ten to twelve times an hour. The washing tray must not be loaded to the point where the prints mat together and the stream of water cannot keep them moving. Clean laundry tubs provide a convenient washing arrangement for home darkrooms.

The chemical laden water should be siphoned from the bottom of the washing tub over into the adjacent tub by means of a rubber tube. The exhaust end of the tube should be placed in a quart fruit jar so that the washing compartment cannot inadvertently drain dry. Various accessories such as tray siphons and rockers provide efficient means for changing the washing water.

Prints wash more slowly in cold water than in warm water. Whenever possible, the wash water temperature should be maintained between 65° and 75°F. If the temperature falls below 65°F., the washing time should be increased considerably. A wash water should not be used at a temperature above 90°F., or swelling and softening of the gelatin may occur.

Hypo Elimination. Since an enlargement of good quality deserves maximum permanence, it is desirable to eliminate traces of hypo that remain in even a well washed print. However, the hypo-eliminating bath should be one that does not itself produce or leave any other harmful residues in the emulsion. A practical and safe formula is one that contains ammonia and hydrogen peroxide (e.g. Kodak HE-1). Further steps toward permanence can be taken by coating the silver particles of the print image with a noble metal such as gold. This minimizes the effect of gases in the air, such as hydrogen sulfide. A suitable formula for this procedure is Kodak GP-1.

Drying. When washing is complete, the prints should be placed on a clean glass or oilcloth-covered board for swabbing off the excess water. They can then be dried on clean cheesecloth stretchers or between clean photographic blotters. If any prints are imperfectly washed, they contaminate the drying supports with hypo which will then be transferred to other prints. If there is doubt as to hypo content, in an emergency the prints can be dried by hanging them with a corner clipped to a line.

Prints on cheesecloth stretchers or hung on a line do not dry flat. Prints can be straightened after drying in commercial print straighteners or in homemade presses. Print backs should be dampened with a soft sponge or tuft of cotton which has been dipped in water or equal parts of alcohol

and water. The prints should then be placed between blotters or cardboard under heavy pressure. They dry flat in two or three hours.

When blotters are used for flat initial drying, the prints should be drained thoroughly, placed between blotters, and weighted down for five or ten minutes. They should then be transferred to fresh, dry blotters, and allowed to dry. The blotters must be of special photographic quality. Ordinary blotters usually contain impurities which cause fading of the prints.

THE VALUE OF GOOD TECHNIC

Using care in handling enlarging paper takes no longer than doing the work carelessly. When the ease with which good photographs can be made is compared with the tedious years of learning required for painting, etching, and other fine arts, the photographer should feel like singing a paean of thanks at $f/1.9$ to enlarging paper. Of course good technic alone cannot produce a photographic masterpiece any more than perfection in etching technic is the only requirement for an artist-etcher. The photograph, in order to be a work of art, must be the artist-photographer's story of a worthwhile experience understandably conveyed to his fellows. A print of good quality stamps the photographer with the distinction of being a careful technician and thus gains attention for his print. A print of good quality does more however, for the satisfaction experienced in producing it subtly fires the inspiration of the photographer and helps him become a careful artist.

JUDGMENT IN ENLARGING

Choosing the Contrast Grade of the Paper The most common error in judgment is to print a negative on a grade of paper that does not have enough contrast; the print looks flat and muddy. Contrasty prints are bad too and statistically should occur as frequently as flat ones. Oddly enough this does not happen. The probable reason is that a print in the hypo tray looks more brilliant than it will when it dries. Thus, a contrasty print is easily noticed while a slightly flat print looks all right (until it dries). This is particularly true of matte prints. Judgment is required in making an

allowance for this drying change. It can be acquired by remembering the appearance of prints in the fixing tray and then noticing how they appear when dry. It is often helpful to tilt the darkroom safelight away from the hypo tray and then examine the prints by the dim yellow light reflected from the walls. This makes the prints appear darker and less contrasty and thus, if they look acceptable under these conditions they probably will be acceptable when dry.

A print that is a trifle flat or contrasty is often not recognized as such until it is compared with a better print. Great deviations from good contrast are not hard to detect. Choosing the correct grade involves judging the contrast of the negative before it is put in the enlarger and also judging the appearance of the print. Both can be learned easily if conscious efforts are made to increase proficiency.

For the beginner a good practical way to arrive at the right contrast is to make a series of prints on papers of different contrast grades. With a series before him the photographer can easily choose the print that suits his taste. (See Figures 14, 15, and 16.) A useful and economical procedure is to make the contrast series by contact, or slight enlargement, then to dry the prints and to choose the best one. The chosen print can be put into the hypo with subsequent enlargements for the purpose of arriving at a good enlargement. Once the correct contrast grade for an enlargement has been found it is a good idea to put the paper grade number on the edge of the negative with pen and ink for future reference.

Correct Exposure A good print should have detail in shadows and in important highlights. Specular highlights such as catch lights in eyes and bright reflections of the sun should be perfectly clear. Small, unimportant shadows can be black. Personal taste enters into the decision for correct exposure. However, the darkening that occurs upon drying should not be forgotten. Making an exposure series, as in the case of contrast series, is an extremely useful aid in finding the correct exposure. (See Figures 17, 18, and 19.)

Choosing Paper Surface and Tint. This selection is governed by personal taste and the



FIG. 14. CORRECT EXPOSURE AND PAPER. Compare this print with Figures 15 through 19. Notice that here there is detail in both the black shadows and the highlights. Good tone gradation over all is important and saves much trouble



FIG. 15. SOFT PAPER. This print was made on a paper of a scale one contrast grade too soft. Notice the lack of good blacks, the lack of brilliance in the highlights, the general muddy effect. Prints like this should be "filed" in the waste basket



FIG. 16. HARD PAPER. This paper was one contrast grade too hard. Here the velvet is a good black, but there is not any detail in it. Also there is no highlight detail and the general effect is one of harshness

intended use of the print. The paper selected should harmonize with the subject and never be conspicuous. Examining prints in leading photographic, scientific, and professional exhibitions and in pictorial salons will aid in training judgment for choosing paper of the proper surface texture and stock tint.

Surfaces have two characteristics, sheen and texture. Glossy surfaces should be used for prints intended for photomechanical reproduction and when maximum detail and tone range is required. For example a crisp snow scene with sparkling highlights, fine snow texture, and rich deep shadows should be printed on a glossy paper for the best print quality.

As the requirements for tone range become less exacting the sheen can be reduced and can range from that of silk textures through lustre surfaces to semi-matte and matte papers. The two latter are particularly suited to high key subjects, that is, ones in which the image tones are predominantly light. But do not send a matte print for publication and expect it to compete favorably with a glossy print.

BROMIDE PAPERS AND BROMIDE ENLARGEMENTS

The extent to which it is desired to show subject detail governs the choice of surface texture. The use of smooth paper removes the tendency to show specular reflections that is possessed by glossy papers; yet smooth surfaces render fine detail almost as well as glossy surfaces. These papers chiefly are suitable for scientific and professional prints. The next step toward a rough surface is taken by a paper with a fine-grained or pebbled texture. These papers are probably the best for general purposes and certainly should be used for portraits of young women and children and for most architectural subjects. Rough papers and those showing a weave should be used for character portraits and pictures in which it is desired to suppress fussy detail in order to emphasize pictorial masses.

The tints of papers vary from a cold white to a warm ivory or buff. White papers should always be used for snow scenes, water scenes, prints to be toned blue and for many high key subjects. Papers that verge on a cream tint are a good choice for general use. The tint adds a feeling of warmth both in the meaning of the subject



FIG. 17. UNDEREXPOSED. Although the correct grade of paper was used, the exposure was not enough. Highlights are washed out and a good black is lacking



FIG. 18. OVEREXPOSED. In this, detail has been burnt out of the blacks and the highlights are muddy. The print is too dark and heavy, though the paper contrast was correct. The tendency—in overexposure—is to “pull” the print. Never shorten development time to compensate for overexposure



FIG. 19. DODGED PRINT. By the principle of dodging explained in the text, the background has been allowed to darken. Compare with Figure 14

and in its actuality. Examples of these are cheerful themes and also subjects lighted by sunlight. Ivory tints suggest mellowness and maturity. Pictures in which the play of sunlight is the main theme are suited to this tint and so are also character studies of adults and interesting views of venerable old buildings.

Image tones, of which there are obtainable a variety from cold black to warm brown, go hand in hand with paper tints. The above discussion can be applied in this case. Toning enlargements to various colors is dealt with elsewhere in this publication. (See article on *Toning*.)

The photographer might despair at this point of ever acquiring judgment in enlarging—there seem to be so many intangible aspects to the subject. He should realize the laborious years of study that would be required to learn one of the other fine arts and also take heart from the fact that the leaders in photography have learned by experience.

The quickest way to acquire judgment is to apply the method of comparisons. To do

this, take a few good negatives of a range of subjects and make contrast series; try bracket exposures; utilize the many paper surfaces and tints; experiment where permissible with developers; apply different degrees of diffusion. Remember, even though mistakes are made at first and an incorrect paper, contrast, exposure, or paper surface is chosen, that learning comes surer to him who carefully picks the wrong one than to him who accidentally gets the right one. The method of comparisons supplemented with a study of the work of accepted experts will soon yield the photographer the good judgment he desires.

SPECIAL ENLARGING TECHNIQS

When a photographer has reached the phase of being able to make "straight" enlargements of excellent quality from his negatives he is ready to learn, if he wishes, the various photographic manipulative techniques. This is not the place to debate the case of purism versus manipulation. However, a few words on both ideas might help the photographer in organizing his opinions so that he can choose his own camp. He can do excellent work in either.

The purist argues that a photograph should depict a fact and that interesting facts only should be photographed. The "impressionist," on the other hand, states that many facts which are uninteresting are nevertheless worthwhile; hence it is the function of the artist-photographer to make them interesting and thus demonstrate their value.

So many profound phrases on both sides are poured forth that the beginner is often swayed from camp to camp and thus is unable to form his own style. The following example of "dodging" will serve as an introduction to this phase of manipulation and also clarify the esthetic issues at stake.

Dodging. Upon making a straight print from a negative it is often found that certain areas are too dark or too light. For example: shadows or highlights might not show enough detail, several dark areas might be separated in the composition yielding a "spotty" effect, or a light patch might distract attention from the center of interest. Dodging is the art of remedying these tone and com-



FIG. 20. DODGING. This shows the technic of dodging. A small piece of cardboard is held—by a wire handle—in the path of the image. Throughout the period of dodging, the cardboard must be moved slightly, to prevent harsh outlines of the dodged area

BROMIDE PAPERS AND BROMIDE ENLARGEMENTS

positional defects by giving unequal exposures to the various print areas (Fig. 20). Purism embodies the art of detecting these defects in the original subject and then remedying them, waiting for them to disappear, or foregoing the exposure. The purist does the latter when the scene brightness is greater than can be accommodated by the photographic process, when he has not control over lighting and arrangement, where natural composition is unsuitable for his purpose.

How to dodge is simple to learn; when to dodge requires judgment. The art is often abused by the tyro-impressionist. His most common but unbeautiful act is to make a picture of a landscape basking in the summer sun and then heavily print in the clouds. He calls it "Approaching Storm"—he loves to make storms approach and they usually materialize when a purist sees his work. Had he been without a filter and for that reason been obliged to make a negative which required extra printing in the sky to depict the clouds *as they were* then he could be excused for dodging. Yet obviously dodging should not be used to falsify the fact by introducing non-existent storms.

The illustration, Figure 21, was made during an actual storm. A light evening thunder shower caused the farmer to pull out his binder and put his horses in the barn for the night. The scene depicted to the eye so well the forces of nature that often threaten the harvest that the photographer might be justified in taking it even though dodging were necessary. The straight print shows how the scene looked to the camera—an uninteresting fact: the dodged print (Fig. 22) shows the dramatic impression the photographer wishes to convey.

The straight print shows that the sun was bursting through the clouds and haze in a position slightly out of the picture on the left-hand side. Notice how hazy and light in tone the left-hand side is; the impression of threatening clouds is removed from the entire picture by this weakness. The straight print was studied and it was decided to "print in" the areas marked with an X to add strength and to "hold back" the area marked Y. A lead-in line is supplied to the picture to take the place of the attention-

getting movement and noise in the actual scene. As a reference, the center of interest, namely the contrast of the figures and the breaking clouds behind them, was to retain the tone values of the first print. The exposure to do this was given to the whole print on the paper board with the exception of area Y. This was held back during exposure with a piece of black paper of the



FIG. 21. STRAIGHT PRINT. This is a straight print of which Figure 22 is the dodged version. The X marks areas to be strengthened by printing in; Y indicates the areas to be held back

right shape attached to the end of a wire. This mask was held about 3 inches above the image on the photographic paper and was kept moving so that a sharp outline would be prevented.

To print the areas X darker, black paper with holes of the right shape was moved over the image in a similar fashion. This procedure gave those areas beneath the holes longer exposure and produced the desired result. The whole left side was darkened by moving a straight sheet of black paper several times from left to right over the projected image, starting from the extreme left



FIG. 22. ENLARGEMENT CONTROL. This is a dodged version of Figure 21. Notice that the print has been cropped for better composition, that the foreground has more detail and interest, and that the sky has pictorial variation

and stopping at the middle. And then departing once from nature, the four corners were darkened by moving the same piece of paper to cover and uncover the corners. Most pictures are more pleasing if the corners are darkened a *trifle*.

The distinction between purists and impressionists should now be clear. When the purists encounter an untractable subject or negative they avoid making a print while the impressionists dodge.

Figure 19 shows how dodging can be used to increase shadow detail and modify backgrounds. The black velvet was held back, and the background was printed in.

Dodging has other uses besides extending the capabilities of the photographic processes. Figures 23, 24, and 25 show how dodging and printing density can be used to produce special effects. These prints were made from two negatives taken in succession with no change in lighting or exposure. They were printed to suit the two moods shown by the subject. Figure 24 shows the appearance of the print before dodging.

The corners in Figure 24 were darkened a trifle and a little holding back was done in front of the face. In Figure 25 the whole background was printed very dark by holding back the head with a black paper mask roughly torn to the head shape. The shape was determined by projecting the image (required size) onto the black paper and then sketching with pencil the outline about $\frac{1}{4}$ inch inside the projected boundary to form a slightly smaller head. The mask then was torn to shape and held in the beam from the enlarger about 2 inches above subsequent prints. It was kept moving up and down

during the printing of the background so that sharp dodging outlines would not be produced; the roughness of the edge of the mask also aided in this respect.

Vignetting Vignetting is a variant of dodging and is accomplished by printing the object of interest through a saw-toothed hole in a black card. During vignetting the card should be kept moving up and down so that no sharp outlines are formed and so that the required shading can be given to the back-



FIG. 23. HAPPY FELLOW. This enlargement was printed light and dodged only at the corners—to preserve the happy mood of the subject. The negative was made under identical conditions as that of Figure 25, yet compare the two

ground. Increasing the distance between card and print will provide a more gradual fading off for the background. Although vignetting has not the popularity now that it once had, it is still useful for high key portraits.

A few precautions should be observed in dodging and vignetting. The enlarger lens should be stopped down so that the general exposure time is not less than about 30 seconds or sufficient deliberation cannot be given to the proposed control. Sharp outlines should not be made, particularly in shading corners; the gradations should be subtle, not obvious. Black cards make the

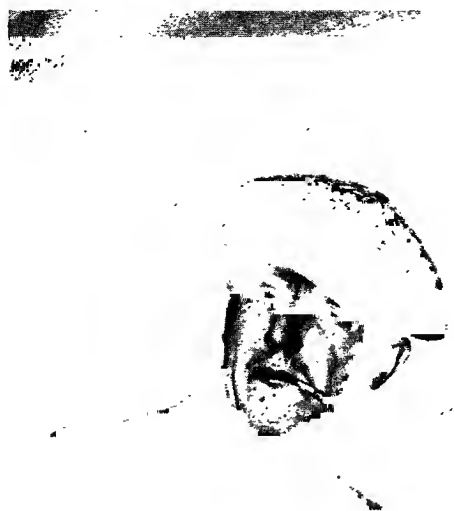


FIG. 24. TOUGH GUY. The costume and the attitude denote a real 'tough guy' but the lighting is the same as that used for the preceding photograph. It is light and happy, far from sinister. Much of this can be remedied in enlarging—as seen in Figure 25

best dodgers; light ones might produce overall fog on the print (especially if fast papers are used) due to light reflected from the image to the dodger and back to the paper.

After expending effort and time on dodging a print, it is discouraging sometimes to find, as the print develops, that one small area is not quite dark enough. A swab of cotton soaked in undiluted developer is often useful to force such areas. However, this practice should not be employed on warm-tone prints or double tones will result because the forced areas will be blacker in tone than the rest of the warm-tone image.

Framing One of the advantages of enlarging is the possibility of selecting a given part of the negative and printing it to the desired size. It is not always possible to frame the scene exactly according to the desired composition in the camera at the time of taking the picture. Pictures often "happen" quickly. For example, Figure 21 shows the entire scene photographed. Figure 22 shows not only the effect of dodging but also the improvement by cropping off some of the unimportant areas. Figures 24 and 25 also show the effect of framing.

This is not the place to enter into the details of composition. The photographer should study the subject and then apply it to his photographic and enlarging technics. As a good aid to judging the compositions offered by framing, it is valuable to make an enlargement from the entire negative and then to use two cardboard "L's" as shown in Figure 26. A good final check on the composition consists of noticing whether the negative image on the paper board presents an interesting design of light and shade. (See article on *Composition*.)

Controlled Distortion. It will be noticed that if the paper board is tilted while the image is projected onto it a change in shape occurs. This distortion can often be used to advantage in restoring parallelism—to the vertical sides of buildings, for instance. The top of the building is given more enlargement than the bottom by tilting the board so that the image of the top of the building is at the low end of the board.

Some enlargers are equipped with tilting legs or other devices for conveniently tilting the paper board for this type of work. When the paper board is tilted in this manner the image should be focused so that it is sharp in the middle. Then the lens should be stopped down to its smallest aperture for the exposure. It is sometimes necessary to print in the part of the picture at the bottom of the board because it is made at a higher magnification than the top and hence requires more exposure.

Other applications of controlled distortion are in lengthening or broadening the faces of portraits for flattering or humorous effects. An unduly, round face can be flattered by lengthening the image. Figures

27 and 28 show how the foreshortening of the girl's figure has been increased by imaging the head and shoulders at the low end of a tilted board. Humorous effects often result from distortion and can be produced by placing the paper on stiff cards bent to various shapes instead of on the paper board.

Two rules should be remembered in tilting the board. First, lengthwise tilt produces a lengthening of the image and a sidewise tilt broadens it. And second, the parts farthest from the lens become most magnified. Thus if, on a vertical print, a building taken with an upward camera tilt is to be lengthened and parallelism restored, then the board must be tilted lengthwise and the image of the top of the building should, of course, be at the bottom of the board.

Combination printing. The most common call for combination printing is for introducing clouds into a sky devoid of them. There are several methods available. The simplest can be applied when the landscape negative has been taken under blue skies with a red filter. The sky portion is then relatively clear and it is often only necessary to place a cloud negative in the negative carrier with the landscape negative and print them together. If, in this case, clouds appear in the landscape shadows, then it will be necessary to make two exposures—one for the landscape and one for the clouds. The negatives should then be projected separately. Cards should be cut with the outlines of the landscape in such a way that the sky can be masked while the landscape is being printed and the landscape masked during cloud printing. The cards should be moved

slightly during printing to prevent sharp lines of demarcation. The outlines can be determined for the mask by projecting the image as described for Figure 25.

The last mentioned method is most easily applied to landscape negatives in which the sky prints white. A good method of masking a negative of this type consists of making an overexposed contrasty positive transparency by contact from it. The foreground should be dark and the sky clear on this diapositive. The negative should be printed for the landscape onto the paper and afterwards, with the red safety-filter over the enlarger lens, pencil marks should be made on the paper at the two extreme ends of the foreground outline. The positive mask and a cloud negative are then placed in the negative



FIG. 25. TOUGH GUY. This is a framed and dodged print made from the same negative as Figure 24. Here the slant of the subject has been changed. There has been a general darkening to give the sinister mood, yet the highlights are preserved—by dodging



FIG. 26. FRAMING. Two cardboard L's, marked in inches, are good for judging the extent of framing

carrier and projected in such a way that the dark, overexposed foreground on the positive is in register with the latent landscape image on the paper as indicated by coincidence with the pencil marks. The positive transparency then holds back any cloud exposure from the landscape while, since the sky is clear, the clouds can be printed in the right place.

Another useful masking method is to support a sheet of clear glass a few inches above the paper board and then to dispose ground coffee over the glass in appropriate places. By projecting the image onto a sheet of paper, the shadow of the coffee forms simulated clouds.

One warning, in combining clouds with other negatives, attention should be given to lighting. The clouds must be lighted from the same direction as the landscape.

The diverse applications of these schemes of combination printing to other subjects are limited only by the ingenuity of the photographer.

FINISHING ENLARGEMENTS

Mounting. After an enlargement is dry it should be checked for quality. If not

found wanting it is ready for mounting. The function of the mount is to disassociate the print from its surroundings. The mount should not call attention to itself by sporting vivid colors, dark tones, complicated pencil borders, or flowery penmanship.

For salon or exhibition use, prints should usually be mounted on 16 x 20-inch card stock. This is carried by artists' supply houses in several different styles and thicknesses, one of the most popular being a pebbled stock, natural white on one side and cream white on the other. Its dual surface characteristics make it suitable for prints on either ivory or white papers.

Since most salons specify 16 x 20-inch mounts, prints for these should ordinarily be made on 14 x 17, 11 x 14 or 8 x 10 paper, and mounted so that the mount always can be hung vertically. If paper larger than 14 x 17 inches is used, there will not be enough border to create a pleasing effect. Prints smaller than 8 x 10 inches are in-



FIG. 27. DISTORTED IMAGE. Not only does this print contain unwanted objects—the tree and the part of the swing—but it is also distorted. The girl's head and the shoulders are too small in comparison to her legs. Figure 28 shows how enlarging can remedy these faults

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clined to look lost unless they have unusual appeal. Sub-mounts are sometimes effective in building the picture elements together. However, sub-mounts should leave only

narrow borders around the picture—avoid a “letter-edged-in-black” effect.

The colors of the mount stock and sub-mount are important. Prints which are in

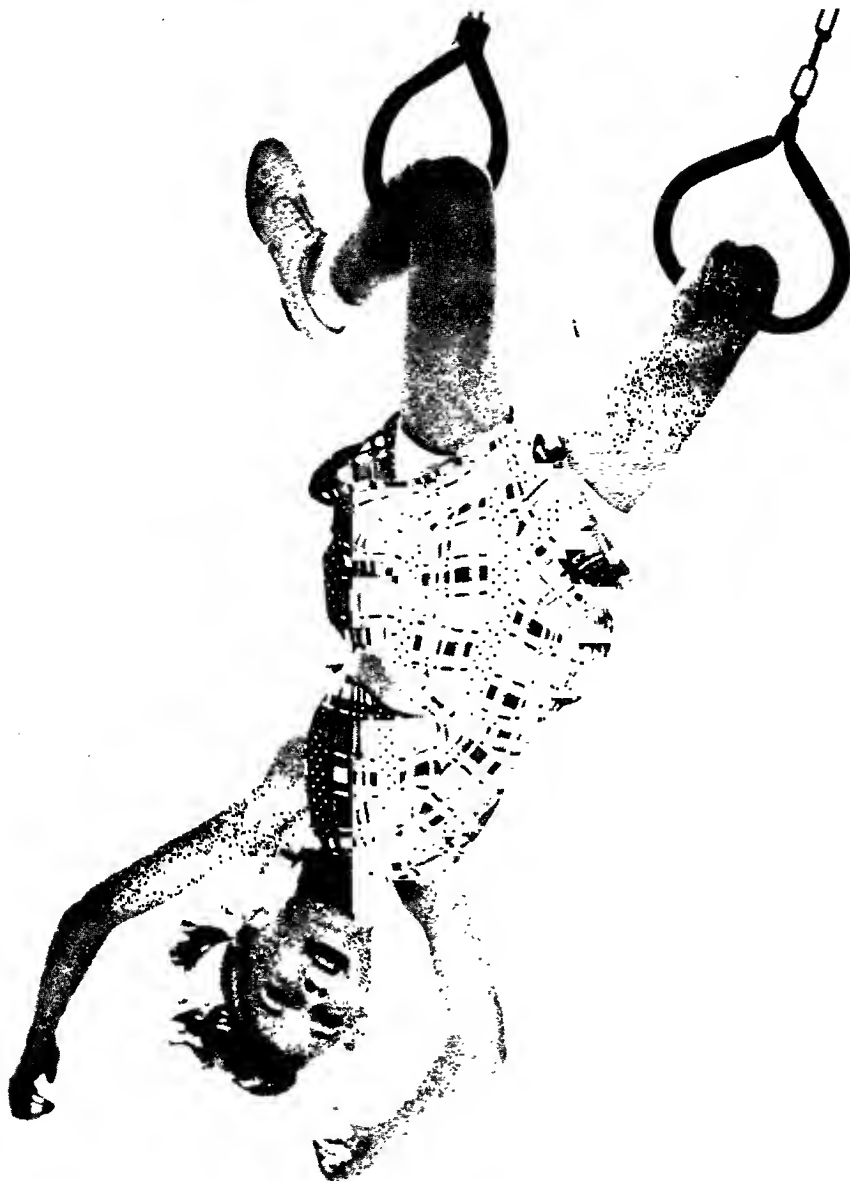


FIG. 28. CORRECTED IMAGE. Not only has there been framing to eliminate the distracting objects seen in Figure 27, but there has also been correction of the distortion. By tilting the paper board the portion of the image farthest away from the negative will be enlarged more than the nearer portions. Thus the head and shoulders will become larger in relation to the knees—an effect which restores correct proportion. When tilting the paper board be sure to have a small lens opening, so that the entire image will be in focus

white stock require white mounts and black or blue-gray sub-mounts. Prints on tinted stock or with warm-toned images should be mounted upon cream or ivory mounts with black or sepia sub-mounts.

Titling can be tastefully done with a colored pencil of the same general tone as the print. The title and signature should be small and neat, yet readable at 3 to 4 feet.

There are several adhesives for mounting prints. Dry mounting tissues are probably the cleanest, safest, and easiest to use. They protect the back of the print and they provide the maximum permanency. A special press or a flat iron is required for heating and pressing for the mounting procedure. A good grade of rubber cement can be used and is clean-working. If the cement is not pure there is a likelihood of chemical reaction with the silver image. Cements containing water should be avoided, because they cause buckling and dry slowly.

Spotting. The final operation in finishing a print consists of spotting out tiny dust spots and other blemishes. Only light toned spots can be spotted on the finished print. This can be done with a soft pencil (followed by a light steaming of the print to imbed the graphite) or spotting colors can be utilized. They should be applied thinly, with a fine pointed sable brush. The wet dot of color is darker than it is when it dries so that judging the density of the spot should be done after it dries (a few seconds after it is applied). If a print is to be waxed for added sheen, then judging should be done immediately for the *wet* spot, since the wax makes the color appear wet. A slight amount of mucilage can be added to the mixing water when spotting colors are applied to lustrous papers so that the spot does not appear to be dull.

Dark spots cannot be successfully spotted on a finished print. Since these come from clear spots on the negative they are usually blocked in with an opaque spotting medium or pencil on the negative. These spots sometimes can be noted on the paper (through the red safety filter) and then pencil dots can be made on their image. The black lead prevents exposure and washes off in the developer. The resultant white spots can be spotted when the print is dry.

Another useful procedure when these clear or thin blemishes are too small to treat on the negative is to etch off the dark spots on the print before it is fully washed. The wet print should be sponged free of surface water and then a tiny drop of Farmer's reducer (diluted 8:1 with water) should be put on the center of the dark spot with a fine pointed sable brush. The droplet should be kept moving over the spot with the brush so that sharp outlines are not etched. When the action has gone far enough the print should be quickly rinsed with water. (If the action goes too far, the light spot can be remedied with spotting colors after the print is mounted). One droplet is often insufficient for a very dark spot so that several might have to be used. The print should be completely rinsed between each application. Prints etched in this way should be placed in the hypo tray for 5 minutes and then washed for one hour in running water to remove all trace of the reducer and the hypo.

The final test for finished enlargements consists of illuminating it approximately in the way that it will be lighted when viewed and then backing off about 15 feet to see whether the picture "carries." Can the story told by the picture be read from this distance? Are certain important lines or areas merged into insignificance with the background? Does the print look flat or contrasty? These are the questions the photographer should ask. If the answers are "Yes" to the first and "No" to the last two, then the enlargement and the photographer have come through with flying colors.

A mounted enlargement is the final proof of the photographer's skill. And if he puts all of his photographic knowledge to work, if he is careful of his technic—there is little reason for failure.

But if failures *do* occur, and they happen with the best of technicians, then honest analysis is in order. He must get back to the source of the trouble—which may be in the lens of the camera, choice of film, of paper, of projection exposure, or perhaps in method and manipulation. Then the photographer will begin again, always throwing his failures away and showing to others only those prints which are good.

BROMOIL AND BROMOIL TRANSFERS

Charles H. Partington

Bromoil Specialist, Photographer

Bromails can be highly artistic pictorial prints. In the bromoil process, the photographer will find freedom to control the texture, tone, and even structure of his work. Part I of this article is an explicit description of the bromoil process—written by an expert. Part II tells about the bromoil transfer, a further step in the bromoil process and one which gives the pictorialist added freedom. The author, in Part II, also has a detailed description of three-color transfers and tells how the color pictorialist can achieve control in printing.

See Also Color—Paper Prints, Control In Photography, Oil Printing Processes

BROMOIL· PART I

THE BROMOIL process in photography represents a specific procedure capable of a greater amount of control than any other printing medium. It is especially suitable for those who aim at producing *pictures* with the camera, instead of straight photographs resulting from the action of light and chemicals only.

Bromoil workers should have the ability to combine artistry and manipulative skill. Any earnest worker who is willing to combine a knowledge of the process with diligent effort in practice, however, will get pleasing and interesting prints.

PRINCIPLE

The bromoil process is a method of producing prints in permanent oil pigments—on the gelatin base of a bromide (or chlorobromide) print. The image is formed by a deposit of pigment from an oily ink, which is applied by a brush to the bromide base.

When a bromide print is placed in a bleaching and tanning solution, the gelatin of the paper will be toughened according to the amount of silver deposit which formed the original image on the bromide print. When a lithographic ink is applied by means of a suitable brush, this ink is accepted in the portions of deep shadow and rejected where highlights are located. Intermediate tones vary, of course, between these extremes.

The image, originally a deposit of silver *imbedded* in the gelatin, is replaced in bromoil by a deposit of pigment *on the surface*. Being thus located, the material forming the image can be removed to reduce density, or it can be increased—thus making local control possible. This feature of the process makes it possible to produce, within reason, varied results as desired.

The steps in making a bromoil print are, in general, as follows:

1. Bromide enlargement is made—fully developed, but with scale of contrasts not too great

2. Print is bleached and dried—image has disappeared

3. Print (now known as the matrix) is soaked in water until highlights swell and a negative relief is formed

4. Print is relieved of excess surface water

5. Inking with engraver's ink takes place—special brushes (Fig. 1) and special technic used

6. Finished bromoil is dried

The bromoil process has been and can be greatly abused either by careless processing of the paper, poor materials and equipment, or lack of attention to the technic of inking. Attention to all phases of the process is therefore important.

It is also an opportune time to mention the following as regards materials, formulas, equipment, processing, and manual work. Many variations apply to these points according to the pet procedure of individual experienced workers. To present all or even a greater part of the different practices would require volumes. It remains, therefore, to detail one certain procedure and this, based on practice with bromoil, can be recommended to produce excellent results.

NEGATIVE QUALITY

There has been some argument about the kind of negative which is best suited to the bromoil process.

The best quality is represented by a negative of the thin, yet snappy variety, in which a full range of tone recording is visible when viewed by light reflected from a white surface. A print from such a negative would show no pure whites in the highlights nor solid black in the shadows. Exceptions



FIG. 1. EQUIPMENT. Shown here are brushes, palette knife, and ink. It is not necessary for the beginner to have so many sizes of brushes, as the medium-sized brush shown in the middle and the two brushes at either side of it would be sufficient

are such highlights as result from water on various surfaces, the catch light in the eyes in portraiture, the glint on glazed ornaments, polished metalware, etc. The other condition of solid black would appear as a hole in a closed box or the shadow line on the edge of a coat lapel in portraiture. Solid black resulting from insufficient illumination of dark objects or areas, should not be seen in the bromoil.

It follows from the above that negatives produced with contrasty lighting or harsh development, or both, should be avoided. Lighting should be soft but not flat. Development should be complete. If proper lighting prevailed, the matter of development should be cared for in a much diluted solution containing a diminished amount of accelerating agent and a prolonged period of immersion

PAPER

The very foundation of bromoil centers on selective tanning of the gelatin coating. It is important that the bromide paper be coated with an emulsion of the soft variety

instead of the harder grade in general use for photographic work. An emulsion hardened when manufactured cannot be treated for selective toughening of the image. As the emulsion may toughen over a period of time, due to atmospheric conditions, it is of value to use paper as freshly coated as possible.

Kodalure, manufactured by the Eastman Kodak Company, or Velour Black, produced by the Defender Photo Supply Company, have emulsions especially suitable for bromoil. The latter offers grades DD, LER, C, N, and I with the first mentioned suitable especially for the novice. While some of the foreign papers are good, they are not as easily or as freshly obtainable as the domestic papers are.

THE PRINT

There is nothing exceptional in producing a print for bromoil but there are a few important points contributing to certain needs of the process.

All prints should have a white border of at least one-half inch. For 10 x 12 or larger prints, a wider border, say three-quarters of an inch, is better. This border serves as a safe edge.

The print should be exposed for a period allowing development of at least three minutes. Development should be complete to produce an image with full depth and range of tones when viewed by transmitted light. While there are several developers that may be of worth in bromoil it is generally conceded by the majority of experienced workers that amidol is ideal.

A stop bath, while not absolutely necessary previous to rinsing after development, will do no harm and insures elimination of the developer action.

(Continued on page 529.)

BROMOIL AND BROMOIL TRANSFERS

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(continued from page 528)

Fixing must be in a plain hypo bath free of hardener, as selective toughening of the gelatin is the base of the process.

FORMULAS FOR BROMIDE PRINTS

Developer

Water	45 oz.	1350 cc
Sodium sulfite		
(dry)	500 grains	32 grams
Amidol	75 grains	5 grams
Sodium bisulfite		
(dry)	75 grains	5 grams
Potassium bromide	15 grains	1 gram

Acid Short Stop Bath

Water	64 oz.	1900 cc
Acetic acid (28%)	3 oz.	100 cc

Fixing Bath

Water	60 oz.	1800 cc
Hypo	10 oz.	300 grams

Fixing of prints requires 10 to 15 minutes, after which they should be well washed. While bleaching is sometimes cared for directly at this stage, it is far better to allow intermediate drying to take place. This tends to improve the inking operation.

BLEACHING

Previous to bleaching, dry prints should be soaked in water until limp. The phase of bromoil generally designated as bleaching is actually the tanning operation around which the process centers. Bleaching and tanning both take place at the same time. The chemicals forming the bleaching agent react with the silver of the image to form a compound that, in turn, is acted upon by the tanning agent to produce chromium trioxide. The latter is responsible for the actual tanning at such areas where the original

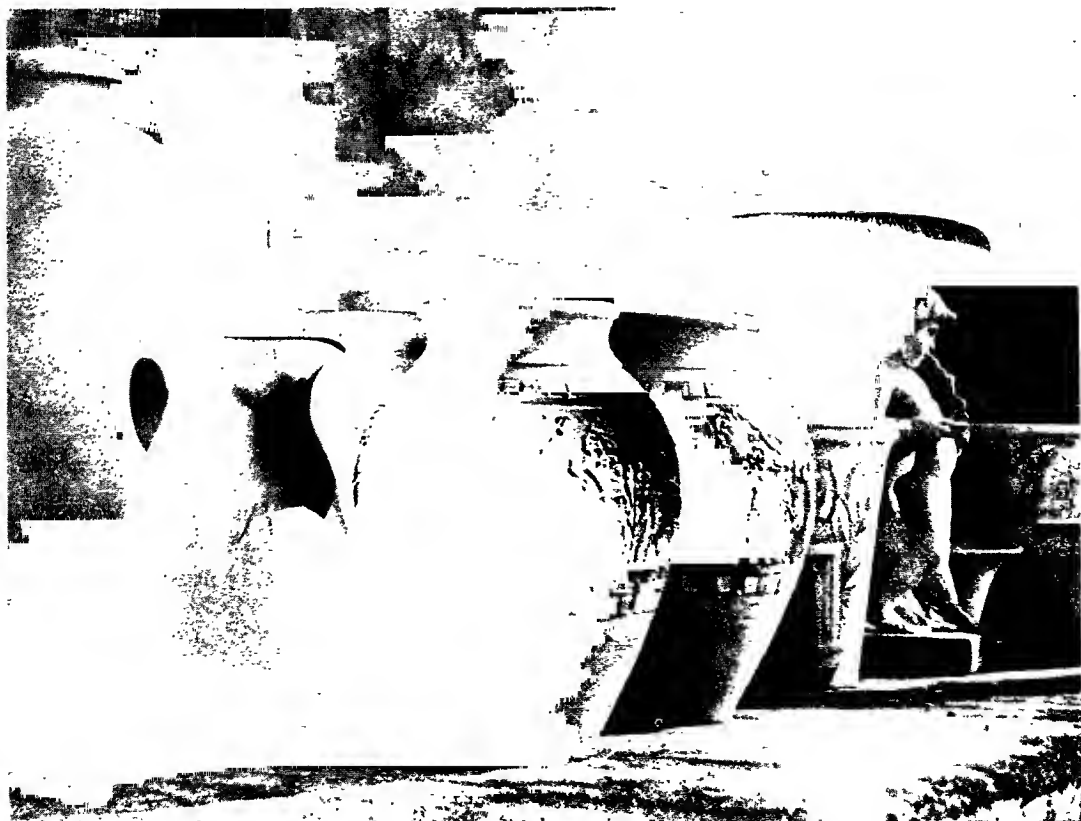


FIG. 2. FIRST INKING. With the first light coat of ink, a bromoil is apt to look washed out. An all-over image should be obtained, however, before local inking control begins, as this is a guide for the brush work



FIG. 3. HALF INKED. Portions of this have been fully inked. Work at this stage should be careful but somewhat swift—unless another soaking is anticipated

deposits of silver were located. The bleach removes the image in the bromide print; tanning serves to harden the gelatin and takes place in direct proportion to the amount of silver present in the image.

Disappearance of the image will be complete in about 2 minutes after the print has been placed in the bleach. Continued immersion for a short period thereafter is of value to insure complete action.

Washing after bleaching and tanning must be thorough as any of the chemicals not eliminated may result in slight general tanning of the entire emulsion. Such a condition would result in partial or complete failure when inking was attempted.

Fixing after bleaching in a non-acid 10% solution of hypo is necessary to avoid stained patches. Wash well after fixing and dry thoroughly. Drying, after any stage of processing is a step toward better results and is best accomplished by suspension from a clip hanger. Such procedure allows

complete evaporation of moisture and avoids uneven action that may result when prints are laid out flat. Uneven drying may result in uneven inking and no amount of hopping can really correct this.

BLEACHING FORMULAS

Bleacher

Water.....	60 oz.	1800 cc
Copper sulfate....	330 grains	22 grams
Sodium chloride (table salt)....	1800 grains	118 grams
Hydrochloric acid— Add drop by drop and shake until fogged appearance clears .	40 grains	2½ grams
Potassium bichro- mate.....	40 grains	2½ grams

Fixing Bath (after bleaching)

Water...	60 oz.	1800 cc
Hypo.....	6 oz.	180 grams
Sodium sulfite....	2 oz.	60 grams

BROMOIL AND BROMOIL TRANSFERS

INKING EQUIPMENT

The necessary inking equipment for a beginner as listed below is really sufficient for the experienced worker. Other equipment is merely a matter of individual needs or desires.

- a. One large bromoil brush, size $1\frac{1}{2}$ inch, for inking
- b. One smaller brush, size $\frac{7}{8}$ or $\frac{5}{8}$ inch, for hopping
- c. One plate glass, $\frac{1}{4}$ inch thick, of a size about 4 inches greater than length and width of largest print to be made. This is the inking support
- d. One small, stiff putty knife with blade about 3 inches long
- e. One piece of glass about 5 x 7 for use as an ink palette
- f. A quantity of bromoil ink and ink-reducing medium
- g. A supply of naphtha or carbon tetrachloride for cleaning brushes, etc.

There are two varieties of bromoil brushes in general use, the bristle and fitch. Made especially for the process, they are round in shape with dome formation on an angle as the working face. This shape is referred to as "stag foot" and establishes the proper angle of contact with the print when inking is accomplished.

The bristle brush tends toward a coarse, grainy effect while the fitch produces an even application of ink, softer tones, and better control. Each style has its own devotees. Good brushes are fairly expensive but if well cared for they will last indefinitely.

Bromoil brushes and ink are obtainable from Photo Utilities, Inc., 10 West 33rd Street, or George Murphy, Inc., 57 East 9th Street, both of New York City, and C. H. Partington, 2780 Highland Ave., Norwood, Cincinnati. In addition, other supplies are also available. The balance of equipment, other than the real specialties of brushes and ink, can be obtained locally as

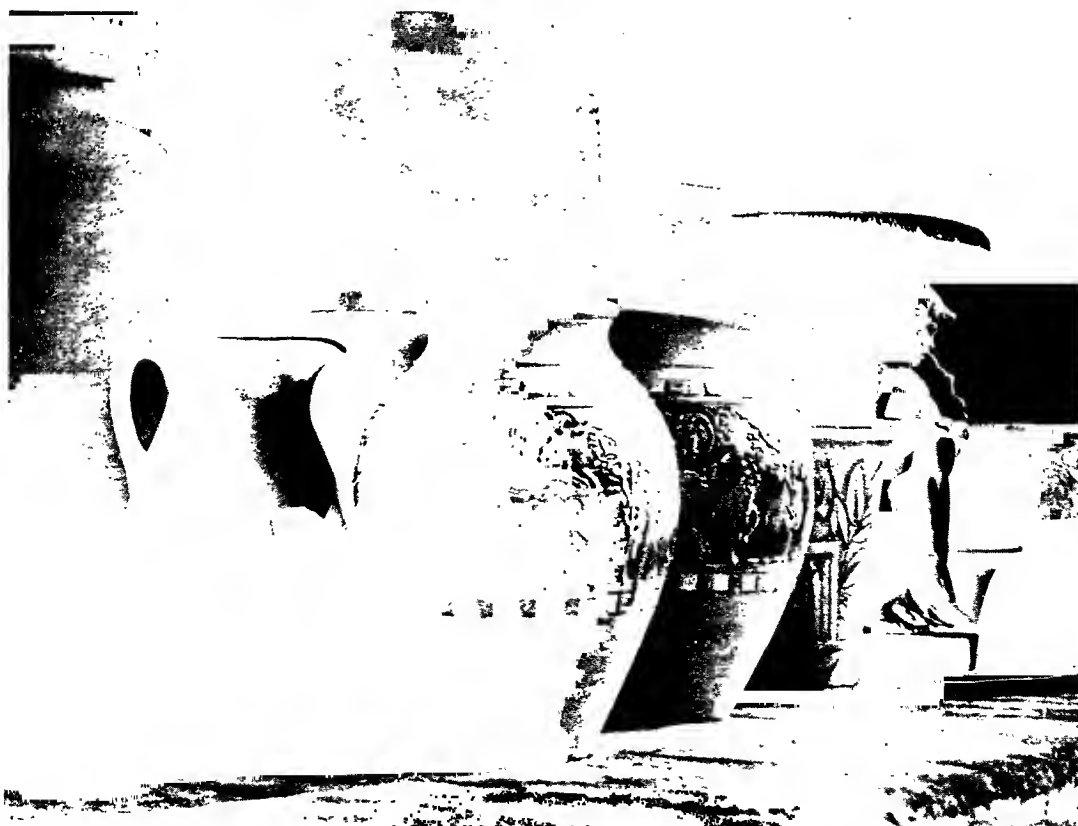


FIG. 4. FULLY INKED. The bromoil now has all of the tones and image contained in a similar bromide print. Hopping and other methods of local control have not yet been used, however

it is general merchandise not confined to the bromoil process.

MATRIX

The original print, after bleaching and tanning, is known as the matrix. After processing, final washing, and drying, this matrix may be put aside until the inking operation is in order. While there have been claims that difficulties may develop if the inking is delayed for too great a period, the writer has had no such occurrence, having had no trouble with a matrix once left accidentally for twelve years.

PHENOMENON OF INKING

It is best at this stage to consider the most peculiar and interesting phase of bromoil—the phenomenon of inking (Figs. 2, 3, and 4).

Since the very beginning of bromoil it has been generally conceded that inking revolves around the fact that oil and water do not mix. The gelatin of the bromoil base is soft in the highlights, but hard in the shadows which were tanned and toughened in processing. When the paper is soaked in water, the soft gelatin of the highlights will naturally absorb more water than the hard shadow portions. A greasy or oily ink, brought in contact with the surface of the matrix would be rejected by the wet surface of the highlights and accepted by the dry portions representing the shadows.

While there is real foundation for the above supposition, the writer felt that the shadow portions were not actually dry. Any gelatin, subject to immersion in water can be expected to absorb moisture to some degree at least. With this thought as a reason for doubt on the matter, the microscope was put to use for close examination of ink acceptance or rejection by gelatin wet or dry, tanned or not tanned.

The following experiment was made. Strips of bromide paper were prepared to represent the various steps in the process of bromoil, as follows:

- a. As received. No exposure, development, fixing, or bleaching bath.
- b. No exposure or development but fixed to remove silver salts and present gelatin only.

- c. No exposure but developed and fixed.
- d. Same as *c* but passed through the bleaching operation also.
- e. Exposed in 4 sections, developed and fixed to produce full black, three-quarter, one-half, and one quarter density with a final fifth section not exposed at all.
- f. Same as *e* but in addition it was made completely ready for inking by bleaching and tanning.

It will be noted that *a*, *b*, *c*, and *d*, having no exposure, would naturally result in a gelatin free of toughening even though receiving the tanning treatment.

These 4 dry strips, (*a*, *b*, *c*, and *d*) when inked gradually and examined under the microscope until they have become completely covered by the deposit, appeared as in Figure 5. The effect was that of applying tar to a stucco wall, where the highest projections scraped the material off a brush first and continued action resulted in excess flowing to the valleys of the rough surface. A cross section of the toothed surface and the result is shown by Figure 6. Keep in mind, these strips were concerned with dry gelatin only, no exposure or developing having been made until *e* and *f*.

Two other sets of strips were soaked in water. One was allowed a period for complete softening of the gelatin while the other was given half such time. With ink applied, the completely soaked strip accepted such slight particles that they were barely detectable while the strip with short soaking accepted enough ink to produce a half-tone. See Figures 7 and 8.

These experiments indicated that dry gelatin, even though smooth to the touch, really has a rough surface of minute projections. When tendered a thorough soaking in water, the projections settle down, not to an absolutely flat surface but to a condition wherein the projections have been greatly diminished. Incomplete soaking does not completely level the tooth. No one knows absolutely what causes this inking phenomenon. From the above, the conclusion could be that it is not the wet surface of the gelatin in bromoil which rejects ink but the lack of tooth that makes the matrix unable to accept it.

BROMOIL AND BROMOIL TRANSFERS

Continuing with the experimental strips, the dry and soaked *e* strips were inked. Needless to say, in the dry state ink was accepted.

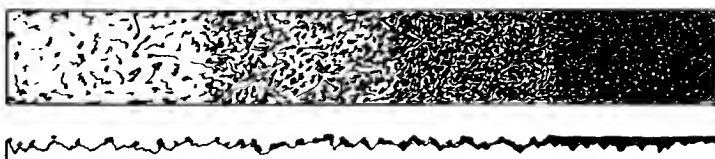
Another set of similar strips, given complete soaking, resulted as follows:

Strip *e* with visible exposed and developed sections due to omission of tanning, accepted some ink in proportion to the density of the silver deposit. This fact indicated that while not tanned, the silver deposit in the emulsion somewhat affected the ability of the gelatin to absorb enough water to completely level the tooth surface. However, while normal application deposited some ink, generous application gave a heavier result.

With the foregoing condition realized, it can be understood that even with tanning omitted, a partial bromoil condition exists. Normal inking would produce little or no deposit but generous application would show results. No doubt the Mediobrome process originated by Leonard Missone is based on this phenomenon, as ink is applied to an unbleached print that has been tendered a thorough soaking period.

The next type of strip for an inking test was *f* with 5 ranges of density. These strips received full bromoil processing and represented the regular matrix. In the dry state, the ink, as could be expected, was accepted over the entire surface and in full density. A soaked strip resulted in an ink deposit varying from white to black in proportion to the density of the original range of exposure of the 5 areas. Figures 9 and 10 indicate the condition of the surface and cross sections.

The original theory of the phenomenon of inking (the wet surface, due to excess water in the untanned portions of a matrix,



FIGS. 5 and 6. These show the four dry strips as they appeared when completely inked. The toothed cross section (below) indicates that ink has flowed into the "valleys" of the rough areas



FIGS. 7 and 8. These show the effect of soaking. The completely soaked strip (above) accepted such a small amount of ink that it was barely perceptible. The one given only half the soaking time (below) presented a somewhat hard gelatin which took more ink



FIGS. 9 and 10. A normal strip—with 5 ranges of density. These show the action of a typical toothed surface. The bromoil is drawn as it appeared through a microscope, from above and in cross section

repels ink and the dry tanned sections accept it; seems to lose force in the face of the investigation described above. Actual observation while inking a toothed surface of a dry or tanned gelatin indicates that ink is literally scraped off the brush. On the other hand, the leveled surface of untanned gelatin, after soaking, has little or no tooth with which to separate the ink from the brush.

It has always been known that the platino-matte surface papers if prepared for bromoil can only be inked with difficulty. Glossy surface papers are practically impossible. In these two cases, the first surface being fairly smooth has only enough tooth to attract a little ink, while the second surface has what is almost no tooth at all.

With the foregoing ideas in mind it may be assumed that the phenomenon of inking in bromoil is concerned with preserving the tooth which attracts ink—instead of retaining water which repels it.

SOAKING

Soaking of the matrix as a preparation for inking is not the mere process of getting the gelatin wet. It is strictly a matter of obtaining the proper condition for producing the inking result desired.

Complete soaking can be accomplished by lengthy immersion in cold water or by a short immersion in a warm bath. The former refers to a period of from 2 to 10 hours at 60° to 75° while the latter is concerned with a period of from 15 to 45 minutes at 80° to 120°. High temperature is only necessary when the gelatin is too hard, either because it is coated or because it is not fresh. If the gelatin is really suitable for bromoil, a warm bath ranges from 85° to 95°.

Where time allows, the cold soaking is preferable. Warm water tends to weaken the gelatin thereby making it more liable to injury. The cold bath, due to long immersion, gives leveling of the tooth in the highlights and at the same time holds a better tooth in the shadows. Inking such a matrix results in cleaner highlights, richer shadows, and better sparkle throughout the entire print.

If soaking at any temperature has been too short, clean highlights will be difficult and shadows will be blocked. If soaking has been overdone, ink may be partly or wholly refused by the half-tones and even the shadows may be difficult to cover.

Soaking, when underdone, results in coarse effects. Shadows lack the real lustre so characteristic of a true bromoil. In addition it may be necessary to swab the inked surface under water to clear the general murky appearance. Resoaking one or more times before inking can be completed, may be necessary to supply moisture that should have been allowed to penetrate at the first instance of immersion.

RELIEF

It is not uncommon to encounter remarks or discussion on the importance or necessity of high relief appearing on the soaked matrix. The untanned gelatin in the highlights will swell due to softness and water-absorbing ability while the shadows remain at a lower level as they represent

tanned or toughened areas which have absorbed only little water. The soaking operation develops the image in the form of relief which in many cases is easily seen.

Lack of relief is not always an indication of inking failure. If the gelatin of the original coating was too hard, little or no relief will appear and inking will be difficult or impossible. Being hard, soaking even to excess will not level the tooth and failure is evident.

Prominent relief comes with a generous coating of gelatin and in general is common to rough surface papers. A thin coating, as applied to certain surfaces, will show little or no relief. However, if the gelatin is sufficiently soft success in inking is certain to follow. It is a suitable coating and not relief that establishes the foundation of successful inking.

INK

Ink for this process somewhat resembles that used in lithography and while this product can, in some cases, be used with fair success, it is best to work with the mixture especially made for the bromoil process. Bromoil, being a process offering the greatest range of control, gains this flexible feature from several sources, among which is the ink itself. The control in such instance revolves around ink consistency.

Hard ink is best. With such an ink, clean lights, detailed half-tones, and brilliant shadows are not difficult to obtain. Hard ink results in contrast and brilliance while soft ink is concerned with a subdued but not necessarily dull rendering.

Some brands of ink, especially in black, are supplied in both the hard and soft variety. Both, however, are not necessary as hard ink can be softened by mixing with a suitable reducer. As only a very small amount of this medium produces a change, care is important when attempting a softer mixture. Diligent use of the putty knife must take place to assure an even blend.

While a proper emulsion and correct processing presents a matrix well adapted to hard ink and full tone values, likewise a soft ink has a particular use. Where the gelatin is especially soft and the power to reject ink is excessive, hard ink would be

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attracted at deeper tones only. Softening of the ink will eliminate the difficulty and improvement will be noticeable at once. Other than a condition of such nature, due to an extra soft gelatin or excessive soaking, the use of a diluted ink is confined mostly to special effects.

Keep in mind that hard ink is used with a suitable emulsion and correct processing and results tend toward contrast and brilliance. Soft ink, in the main, is used with a matrix not suitable to the hard mixture and the effect tends toward softness and subdued tones.

If the original emulsion was not soft enough or if it became toughened with age, tooth in highlights and half-tones will be more prominent than with a proper coating. Also, if soaking was stinted, the same condition will prevail. In such cases, hard ink is a necessity for clear highlights.

INKING

Considering that the soaked bromoil matrix is composed of wet, soft paper and gelatin, and considering that ink is practically pressed on, the necessity of a flat, smooth foundation is obvious. Any ridges or projections beneath the matrix would be reproduced on the print. If the work table does not present a perfectly flat surface, it is necessary to employ a plate glass or metal foundation, the latter of course being of non-rusting or non-corroding material.

While it is possible to place the matrix directly on the support, the tendency to slip or drag up with the brush is sometimes a detriment. The use of a wet blotter under the matrix prevents this trouble. A well soaked blotter is placed on the support and the excess water removed by fair pressure from a hand roller.

The palette should be located close to the matrix support for convenience in charging the brush. A quantity of ink, equal to the size of a pea, is placed on the palette and spread with the putty knife to a thin layer about 2 inches in diameter. As inking progresses, the knife should be used off and on to keep the ink patch smooth.

The soaked matrix is placed on the support and most of the surplus water removed from the surface by means of a viscose sponge or

a clean, soft chamois. Removal of all visible surface water remaining is accomplished by light but firm dabbing with a clean, soft cloth or handkerchief which is fairly free of lint. Be certain that all water has been removed, by glancing obliquely at the surface to catch the glint of any wet spots.

Inking is usually accomplished by using a brush made especially for the process. Formerly some work was performed with a plush roller and in late years the electric brush has been used. Such appliances are more a matter of saving time and results do not compare with hand manipulation of the typical brush. It must eventually be used anyway to clear the crude results of the other tools.

The bromoil brush hairs have tips which are natural needle points and not like the ground stubs found in paint brushes. The idea is to pick up extremely fine particles of ink and to deposit these on the matrix in the smoothest possible manner.

To charge the brush properly it is dabbed in the ink patch with about 10 to 15 rapid strokes about one-quarter inch long. It is then dabbed, in like manner, on a clean portion of the palette to remove excess ink and present an even distribution over the tips of the hairs before applying to the print.

Holding and operating the brush is difficult and important. Applying ink to the print involves a certain amount of artistry and technic, which, while being the natural talent of the few, must be developed by practice in others.

For the best results in reproducing a full scale tonal range, for a perfectly even coating of ink free of patch effect, and above all for least manual fatigue, holding the brush in suspension is highly recommended. This method is shown by Figure 11 with the brush suspended by the very end of the handle between the thumb and third finger while the index finger against the tip applies pressure.

Gripping lower, at the body of the handle, is not good form (Fig. 11). This is not only a tiresome procedure but makes it difficult to obtain the beautiful values and richness so characteristic of this process. In addition,

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the life of the brush may be short due to the bending strain on the hairs. As the ink does not have to be stomped into the gelatin there is no need for harsh action.

The suspension method of brush work performs the proper action of scraping the ink off the hair and depositing it on the toothed surface of the matrix. Highlights remain clear even in the face of building up shadows within the same area of brush contact. No great pressure is necessary, there-

Using only a lightly charged brush and applying the quick flexible stroke, the first contact shows only a light tone in full detail. It is an advantage to cover the entire print in this manner previous to building for depth and brilliance. By so doing, the quick, light deposit of greasy ink offers somewhat of a shield against too rapid evaporation of moisture in the matrix. This offsets the necessity of one or more resoaking periods before inking is completed. It affords the



FIG. 11. BRUSHWORK. The illustration at the left demonstrates the *correct* handling of the brush. Notice that the index finger applies the pressure. The middle illustration shows *improper* handling, where too much pressure is applied. The right hand illustration indicates the position for *hopping*

fore no breakdown in the gelatin will occur to mar the lights or produce a coarse granular effect.

Holding the charged brush as described and shown by Figure 11, apply an up and down motion at the rate of 8 or 10 strokes per second going no higher than about $\frac{1}{16}$ inch above the surface. By pressure from the index finger at end of handle, flex the tip of the brush hairs just enough to feel a cushion effect. Keep in mind that ink is to be practically pushed against the microscopic toothed surface of the matrix.

Begin at any selected point and work outward, in all directions over the balance of the print area. Remember at all times to have the brush only lightly charged and that this small quantity of ink is soon distributed; therefore frequent recharging from the palette patch is necessary.

experienced worker free reign to finish a print as large as 16 x 20 without the slightest necessity of resoaking.

HOPPING

The suspended brush method of inking, especially after practice, renders complete depth with no excess ink to be removed from the shadows. The result will be clear, but brilliance may be lacking. In such case, keeping the brush lightly charged, slow the stroke speed by half, hardly lift the hairs off the surface, but make the upward movement a sort of pull back. The slower push downward deposits a little more ink in the shadows to add richness while the pull back effect removes any slight excess deposit at half-tones and lights. Such action results in additional snap generally and is called "hopping." See Figure 11.

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A patchy result, that is, variation in density throughout the print is the cause of much woe to some workers. Such a result is due either to not keeping the brush lightly and evenly charged, to working longer in one spot than another, or to a brushing rate too rapid for the amount of ink applied.

Provided the original print, previous to bleaching, was of full tonal range, hopping to improve any areas is unnecessary. Where there is need for such procedure due to blocked areas locally or overdone inking generally, proceed as follows to lighten the heavy deposit:

Where no drastic action is required, the inking brush itself can be used. Considering it to be one of the preferred larger sizes, it is held in suspension the same as for inking except that the thumb and index finger only are used with pressure omitted. Figure 11 shows this idea. The action concerns a stroke with the same speed as inking but using about $\frac{1}{4}$ inch of lift. The brush, lightly suspended between two fingers, then performs a light pounding effect.

Where excessive hopping is necessary a clean brush should be used. For local reduction use a smaller brush. The light brush is held between thumb and forefinger about 2 or 3 inches above the hair and, from 1 inch away, is thrown against the surface and caught on the rebound. The stroke may be slow or fast as required.

RESOAKING

Many workers resort to resoaking one or more times before a print is completed. If such procedure is necessary it is due to improper processing of the matrix, incomplete original soaking, or brush work that is too slow in producing results. If resoaking is performed, all moisture must again be blotted from the surface. Any runs in the ink which may be termed water marked, disappear with later brush action.

Another practice sometimes performed is that of swabbing. This concerns the use of cotton while the print is under water in a tray. This procedure is often mentioned as a method to brighten the print generally and clear the lights in particular. It will do just that but leave, in most cases, a crude granular effect not at all a natural texture

in a good bromoil. The need for such procedure acclaims poor processing or lack of brush technic or both.

Resoaking may be all right for the beginner who, lacking experience and ability, cannot cover the print before evaporation sets in. Also, due to the lack of sufficient practice, an excess application of ink may make swabbing necessary to produce a more presentable job. Beyond these conditions, neither resoaking or swabbing should be in order.

BRUSH CARE

After completion of a work period in bromoil the palette and putty knife should be cleaned. The brushes need special attention and even the dry ones used for hopping must be cared for. The best cleansing mediums are naphtha or carbon tetrachloride. Dip the brush ends in one of these liquids and wipe off against clean paper until all evidence of ink is cleared. Set brushes aside to dry after which they should be kept under cover to avoid accumulation of dust.

Brushes cleaned with naphtha will be thoroughly dry within 24 hours. Using carbon tetrachloride requires only 1 hour or less for the same result. If brushes are again used before complete evaporation has taken place, especially in the case of naphtha, dilution of the ink will follow and the detriment of extremely soft ink can be expected.

PRECAUTIONS AND SUGGESTIONS

The worker should not use an eraser or etching knife to clear lights, large or small, *after the print is dry*. This method is crude and will appear as such. The use of an artist's paper stump, wet at the point, will clear any sharp lights *while print is wet*. For larger spots, a small tuft of wet cotton twisted on the end of a match, is quite serviceable.

If sky is blank and a suggestion of clouds is desired, use a small wad of wet cotton. Should the sky area be perfectly white thereby offering no background for clouds, darken the section just a little by applying a softer ink. Wipe in cloud forms as desired and blend the resulting bald effect with a small dry brush. Artistry and practice are again of value with such an operation.

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Regardless of whether a completed print resulted from straight inking only or whether it involved the use of one or more control features, the main thing to keep in mind is *when to stop*. There are too many bromoils that fairly scream, "Overdone!"

The bromoil process, depending for success not only on the action of light and chemicals but on a physical condition involved with gelatin, presents more chances for difficulties than encountered in most methods of producing prints. Provided all materials and processing are correct, excellent results will follow. Sources of failure in a number of cases are mentioned throughout this text, but a number of causes for difficulties are given here for further emphasis.

Brown spots on matrix appearing after bleaching may result from bare metal of enameled trays but more likely from dry amidol which has contacted the emulsion previous to development. Handle dry amidol with least agitation possible.

Fixing and washing must be thorough and the latter is best accomplished by soaking and draining. Allowing prints to remain in water for at least 5 minutes in each of 8 or more changes, and draining each print well before placing in another bath, guarantees better elimination of chemicals than running water which does not always reach the entire surface.

Every trace of tanning chemicals must be removed after bleaching and therefore washing at this stage is the most important of all. If these chemicals remain in the emulsion the gelatin when dry and exposed to light will show a general tanning. Even highlights would be affected and the production of a clear inked image would be difficult or impossible.

Water, according to locality, may offer trouble. Distilled water for all chemical solutions may be necessary and it is recommended *at all times for the bleacher*. Hard water will in most cases be a detriment to soaking of the matrix or may even destroy the real foundation for bromoil when used in general washing by offering a slight hardening effect to the gelatin.

Paper must not only have a coating suitable to bromoil but it must be fresh. Even though the expiration date holds leeway for

making an excellent silver image, atmospheric conditions and time may produce a slight hardening so detrimental to gelatin for bromoil.

Some bleaching solutions tan only the deepest shadows and darker half-tones. It is almost impossible to gain even middle tones with hard ink and this condition can be so extreme as to require the very softest consistency to produce the lighter tones. With such soft ink, shadows will then be flat and blocked.

A bleacher that works too slowly often leaves too much of a visible image on the matrix which may penetrate the pigment and degrade the tonal quality. The bleaching formula included in this article is the selection of all that have been subject to test. It is honestly recommended as reliable.

While it may be economical to use solutions almost to a point of exhaustion, such procedure is not well adapted to producing good bromoils. Amidol developer has poor keeping qualities and should always be made up fresh. The bleacher is often mentioned as being serviceable as long as it removes the silver image. This however is not correct as bleaching may take place while the tanning effect is weak. Formulas given for developer and bleacher can be guaranteed for eight 11 x 14 prints and it is best to confine the action to this equivalent. Hypo is cheap and therefore a fresh fixing bath should always be in order.

It should be well remembered that success in bromoil requires a suitable emulsion, proper processing, thorough washing, and correct soaking. Proper processing means good chemicals and such are especially important where the bleaching and tanning solution is concerned. Use C. P. (chemically pure) salts, especially the copper sulfate and potassium bichromate, as these may otherwise contain foreign elements quite detrimental to bromoil processing. By diligent attention, the worker can produce a proper matrix and from this point a satisfactory print depends upon inking ability and technic.

BROMOIL TRANSFER. PART II

The bromoil transfer process involves transferring the pigment image of a bromoil

BROMOIL AND BROMOIL TRANSFERS

print onto the plain surface of any other piece of paper. A transfer results from the procedure of placing the freshly inked bromoil in contact with a sheet of suitable plain paper, applying pressure, and separating the two sheets. Ink from the bromoil is transferred to the plain paper, offering a print formed only by a deposit of pigment with no gelatin foundation. A bromide print intended for transfer should be reversed when the enlargement is made, as the final image is the opposite of the original.

Some workers produce transfers exclusively and it will therefore be well to compare the quality with bromoils.

Bromoil, at all times, produces more depth and brilliance than was rendered by the original bromide image. The pigment being located upon the surface of the gelatin and, even when dry, retaining a sheen from the grease vehicle, results in an effect more luminous than the silver imbedded in the emulsion.

The transfer, on the other hand, presents a rich, dull, velvety effect entirely different from the bromoil, yet beautiful in its own way. The bromoil transfer has the advantage over straight bromoil that more control is possible. Also, when the image has been transferred from the matrix, it can be re-inked and the transfer process can be repeated many times. At times, certain picture subjects will satisfy in bromoil but not as a transfer. Likewise, the reverse is true. It remains for individual taste to establish which form of an ink picture is desired.

EQUIPMENT

There are many kinds and grades of paper suitable for the transfer. For monotone work, a French paper known as "Ingres" renders excellent results. This is available in white and numerous shades. For full color work from three-color separation negatives, a stock known as "Aquarelle" is quite satisfactory.

These papers, as well as many others may be obtained from The Morilla Company, Inc. located at 34-36 Cooper Square, New York, N. Y. Sample books of various papers can be had from which to make a suitable selection.

The production of a transfer involves pressure applied in some form and is best when supplied by a suitable press. At times, nice work has resulted from pressure obtained with the common laundry wringer but an appliance made especially for bromoil transfer renders the best deposit and offers the most convenience in operation. There are two distinct forms of presses manufactured for the purpose. One is the two-roller type, similar to the wringer idea, where the work is pulled through by friction. A crank is applied to one roll while pressure, more or less, is obtained by screws which vary the distance between rolls.

The other type of press is concerned with a single roll operated by crank through reduction gearing. This allows a slow and smooth action. The roll, having a gear at one end meshing with teeth in a rack applied to a traveling table, propels the latter. The print pack placed on the table is not subject to a friction drag but merely rides under the roll and receives pressure as it passes. The position of roll and table being fixed, the need of adjusting screws is eliminated. Pressure, more or less as needed, is secured by the mere addition or subtraction of one or more sheets of paper to the print pack. With the thickness once established, the same pressure is assured at all times. The single-roll traveling table press is known by the trade name *Transit*.

THE SINGLE TRANSFER

In making a transfer, the difficulty of adhesion resulting in damage to the matrix, has often been a problem. To offset this trouble, various workers have resorted to spraying the transfer sheet with turpentine, coating with a weak starch solution, etc. However, none of these ideas insure a cure for the difficulty as well as the simple procedure of dampening the sheet with water.

The lengthy procedure of soaking and then placing the sheet between blotters under pressure previous to use is not at all necessary. Soak transfer paper in a tray while inking the bromoil. When it is ready, place it on a clean blotter and remove surface water with a viscose sponge. It need not be mopped as dry as the matrix previous to inking.

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It has been determined, by continual practice, that when transfer is intended, the matrix should be soaked in warm water as it renders the gelatin softer and more pliable. Starting with an initial warmth of practically 95° and allowing soaking to continue

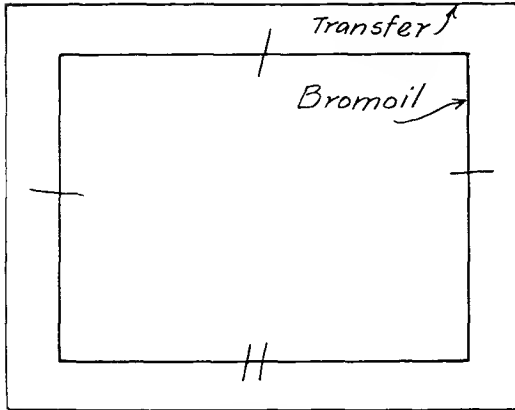


FIG. 12. To center the bromoil for multiple transfer, markings should be made as indicated. Notice that one side has a double mark—to prevent reverse placement

until the water in the tray lowers to room temperature, provides suitable conditioning of the gelatin.

After pressure has been applied, stripping of the bromoil should occasion just enough adhesion to require a firm and steady pull which emits a slight hissing sound as separation of the sheets takes place. This light adhesion is practically a necessity in proper transfer of the ink. Where little or no adhesion exists and the bromoil can be lifted instead of stripped the transfer will be weak in volume of ink deposit and poor in tonal range.

The print pack, mentioned previously, varies in make-up for the two types of presses. With either machine, the main section of the pack includes two blotters, the bromoil print, and the transfer sheet. With one blotter beneath the transfer sheet, place the bromoil face down on the latter and cover with the second blotter. Excess moisture driven out by pressure is taken up by the blotters.

When the double-roll press is used, the four sheets arranged as above are placed between two thin sheets of metal when passed through the rolls. The single-roll

traveling table press guarantees greater resiliency as the space for passage of the pack is about $\frac{1}{4}$ inch. This excess over the four sheet combination is cared for by sufficient additional blotters or cardboard.

The amount of pressure required is difficult to state as there is no means of establishing or checking a definite force. A crushing effect, sufficient to curl up the blotters is not at all necessary. A few trials will establish this feature of proper pressure.

Full pressure at one pass of the pack will, in most cases, result in a bulge or wrinkle in the matrix at the end of travel. A blurred image may also be produced. Pressure should be light at the start and increased a little for each of four or five successive passages. This establishes gradual adhesion and allows for stretch of the matrix. The screws on the two-roll press supply the variation between passes while the single-roll machine simply requires another sheet of thin paper such as newsprint, for each increase in pressure.

Where the transfer is to be obtained from a single impression, results can be improved somewhat after full pressure has been applied by lifting the matrix first on one end and then on the other, doing this in sections to avoid slippage and consequently a double image. Exposing to the air in this manner for a few seconds and then again applying full pressure produces a slightly richer transfer of the ink.

A single transfer from a matrix first worked with hard ink and then followed by a light application of the softer consistency, will also produce a better quality.

MULTIPLE TRANSFER

No matter how nice a single transfer may be, the multiple print resulting from two or more impressions, each from a newly coated matrix, will render a quality not obtainable by any other method. However, much depends on reliable registration of the several impressions and the most simple and accurate procedure is outlined as follows:

After pressure has been applied and *previous to stripping the matrix from the transfer sheet*, apply a pencil mark to each of the four sides, approximately in the center. These marks need not be ruled, simply free-

BROMOIL AND BROMOIL TRANSFERS

hand strokes beginning about $\frac{1}{4}$ inch inward from the edge of the matrix and extending out over the transfer sheet. Matching these four freehand marks at each successive impression establishes correct registration at all times. Two marks on one side prevents possible reverse placement after first impression (Fig. 12).

Multiple transfer offers additional control in the form of one impression of hard ink and the other of soft ink. Certain areas may be transferred on first impression and inking omitted at this point for the second pass. Certain dark areas may be inked, and transferred more often than the balance of the print.

"PO-NEG" TRANSFER

An idea of a new and odd, yet pleasing presentation in a transfer, was gained while viewing an exhibition of drawings in an art school. Charcoal drawings on dark toned paper with highlights in white chalk seemed worth a trial in bromoil transfer. Dark-toned paper for such a transfer is available in the "Ingres" stock mentioned previously. Green, gray, and tan are suggested as offering nice effects.

The name of "Po-Neg," given to this form of transfer, is based on the fact that to produce this effect a positive and negative matrix are used. A positive transparency is first needed and, from that, a negative print on bromide is made. This negative print, representing an image of the highlights and lighter tones, is *inked in white*. Due to the necessity of obtaining a good body of white to cover the dark toned paper, from two to five impressions are required.

The white image is transferred first and must be thoroughly dry before the transfer receives the impressions of black ink. The black may require only one impression, or at the most, two coats.

Registration of the two images must be established by the original negative onto which marks made by a soft pencil or pen and ink are applied. These marks will show on the positive transparency and appear eventually on all prints. *Previous to bleaching*, using a ruler to contract a pair of marks on opposite sides of the prints, extend a pencil line across the white border used as a

safe edge. See Figure 13. With prints face down on a printing light or other source of illumination, retrace the marks to appear on rear of sheets.

When the first white impression is made, and *before stripping*, extend the marks, using a ruler across each pair, out over the transfer sheet. These marks on the transfer are then matched for all following impressions.

The Po-Neg transfer has no value unless the dark toned paper is visible as a foundation. The effect is that of a charcoal-chalk sketch. Such an effect is provided in a portrait, for instance, by inking head and bust only, the latter being blended off toward the bottom. Any ink beyond the subject is wiped away on the bromoil with wet cotton to outline the area desired. As white ink on white paper is almost invisible it is best to apply a soft pencil to the rear of the positive print, using transmitted light from a printing box, and outline the image desired. Place the negative print in register with the positive and trace the lines so that both coincide. After inking either print, place face upward over the light and wipe off the ink to match the pencil outline on the rear.

The effect of a sketch can be enhanced by a little foreign touch produced by hand

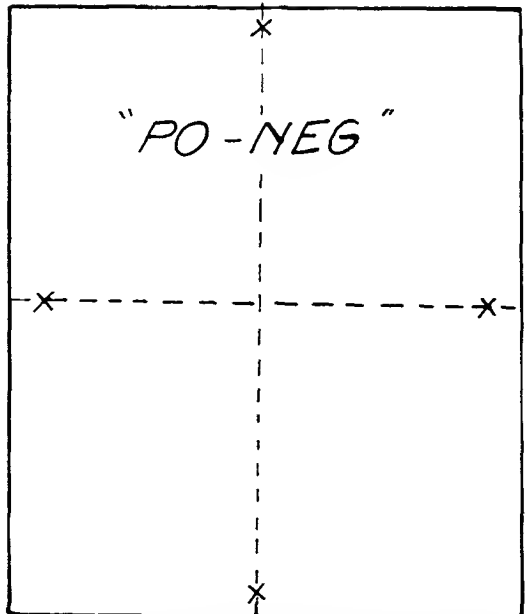


FIG. 13. When aligning the Po-Neg transfer, previous to bleaching, marks such as these are made on the prints. Explained in the text

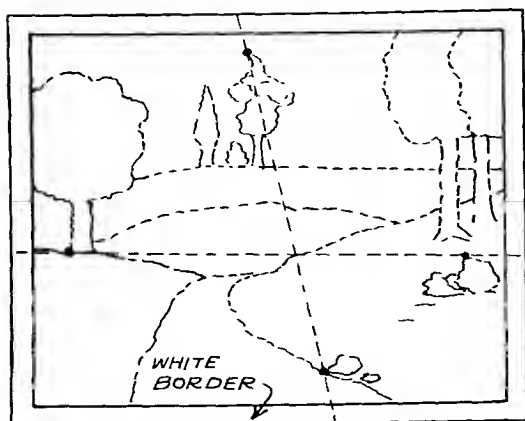


FIG. 14. In three-color transfer work, two portions of the image common to all three colors must be used for alignment. This method is explained in the text

strokes with a small water color brush charged with ink diluted with naphtha. A few sketchy strokes around the edge of the image will transfer perfectly.

Such a print with a base of dark toned paper, a black positive image, and applied highlights in white is quite effective and well worth the effort involved. Using pale rose paper and red ink for the positive impression or a light blue-gray paper and blue ink offers interesting combinations in addition to the regulation black image.

THREE-COLOR TRANSFER

With the several processes involved to produce full color prints on paper, little or nothing is said in favor of bromoil transfer. Yet the effort concerned is no greater nor more difficult than necessary with other methods.

Generally speaking, the main features are the same as those of a good transfer in monotone. Beyond this, the only additional instructions apply to registration and certain control. It is taken for granted that a set of three-color separation negatives are at hand, but if not, their method of production can be found by seeing the article on *Color Photography: Making Separation Negatives*.

Registration must be effected with the set of three prints *previous to bleaching* and centers around the selection of small details in the subject matter which appear on *all three prints*. Due to color separation, a selected point on one print may not appear on the other two images.

Previous to bleaching locate a commonly visible detail at top and bottom of each print and as near as possible to the safe edge border. Using a ruler or straight edge placed accurately along the two selected spots, project lines across the white border as indicated in Figure 14. Do likewise with left and right edges and then, by transmitted light, as mentioned with the Po-Neg work, transfer the lines to back of print. The registration points are best near the center of each side if possible but it is more important that they be nearly opposite. Registration is less troublesome if marks represent a right angle relation.

Tri-color inks are available and a transfer of any one color should be allowed a drying period of at least twenty-four hours before another is applied. Lack of drying will result in the color on the transfer being offset by the matrix of the color that follows.

Where true rendering of the original colors is desired, it remains for the experienced worker to produce such results, as much depends on the ability to apply uniform applications of each color. However, for pictorial work the concern is with a picture in colors and not merely a color photograph. Variation in color or shade is of no real consequence. The beauty and interest in most paintings centers on colors not as they actually appeared, but as the artist saw or desired them.

The various points of control available in monotone work can also be applied to three-color prints. No other process of full color prints on paper offers the advantages of bromoil transfer to alter locally or even to change colors entirely. Red may be intensified when desired or blue may be reduced a little. Green may be changed in hue by applying more or less of blue or yellow.

Where drastic change is called for—as when a green house merges with the foliage in a landscape, simply omit inking this area in the blue and yellow which produce the green. When making the red impression, take the blue or yellow printer on which the house appears, ink this object in red and transfer separately.

The sequence of color impressions has been proved, by lengthy experimentation, to be of no particular consequence. The red with

CALOTYPE PROCESS

its penetrating power can be applied first and thus is reduced in domination. With portraits however it is best to apply red last as it is quite a factor in rendering a satisfactory flesh color. A light impression at first is recommended and more may follow.

Much could be written on three-color transfer as the possibilities are legion. However, the least said the better as practice in producing such prints will reveal the wide scope of effects, control, variations, etc. available.

DIFFICULTIES AND SUGGESTIONS

When a transfer is made, the border of the bromoil may be cleaned perfectly with a wad of wet cotton. This results in clear paper around the transferred image and produces a nice effect in a cut-out mount. A small, narrow sable brush, moistened with ink diluted with naphtha, used to apply a thin, freehand line around the edge of the image on the bromoil, offers a pleasing effect on the transfer.

A matrix used to produce a transfer can be inked up to remain as a bromoil if desired. Where a transfer is made at one time and another desired later, the matrix may be cleared of all ink by swabbing with cotton dipped in naphtha. When dry it can be soaked again and inked as before.

The production of only one or two good prints should introduce the worker to the fascinating possibilities of this process. The production of more prints by continued practice will lead to original ideas and give the photographer the knowledge that he may now *build a picture* instead of merely *producing* one by the limited flexibility of normal photographic procedure.

BUFFERED DEVELOPERS. In order to control the alkalinity (pH) of a developer, buffering is often resorted to. With developers of the metol-hydroquinone-borax type, such as D-76, an increase in alkaline content is apt to result after mixing and this increase causes increased development speed and increased graininess. Boric acid and borax are often used as a buffer to help remedy this increase.

A typical buffered borax solution is the following D-76d:

Metol	2.0 grams
Hydroquinone	5.0 grams
Sodium sulfite	100.0 grams
Borax, granular	8.0 grams
Boric acid, crystals . .	8.0 grams
Water to make	1.0 liter

Actually, most developers are buffered to some degree, as many of the salts are buffering agents. Unlike replenisher, which keeps the developer up to general strength, the buffer keeps the developer at correct working strength—but does this by actually opposing one of the chemical forces within the solution.

In buffered borax developers, the borax and boric acid should always measure the same together. Then variations within that amount, changes in proportion of borax to acid, can control the amount of buffering accomplished—an increase of borax causing an increase of development rate, and an increase of acid causing a decrease of development rate.

CABINET PHOTOGRAPHS.

Before America's Civil War, photographic family albums were literally cluttered with a kind of portrait known as cartes-de-visite. These were about $2\frac{1}{4} \times 3\frac{1}{4}$ inches in size, characterized by extreme ornateness and exaggeration of pose. After the war, in the 1860's, a new size of photograph was introduced from England. This was $4 \times 5\frac{1}{2}$ inches in size and called the cabinet photograph.

Cabinet photographs provided greater scope for portrait photographers, who could now do better work, especially with posing and lighting. As a result of the larger negative, another element entered into portrait photography—retouching of the negative. Portraits became highly 'artistic' and the cabinet photograph extremely popular.

Cabinet photographs were produced in the following way: a glass plate was coated with albumen and then with a collodion layer. Then the silver bath was applied. The plate was developed in acetic acid and iron sulfate and fixed in potassium cyanide. Printing was done by sunlight on paper which was later fixed and sometimes toned in gold.

CALOTYPE PROCESS. In the calotype process a negative is produced on paper by

means of silver nitrate and gallic acid. From this negative an almost unlimited number of prints can be made.

This paper process of photography was invented by the Englishman, William Henry Fox Talbot, in 1835, his experiments having paralleled—in time—those of Daguerre. It derives its name from the Greek “kalos” meaning beautiful and “typos” meaning image. Sometimes this process is called Talbotype in honor of its inventor.

In the calotype process the paper was first coated with salt and then with a silver nitrate solution. In this sensitized condition it was exposed for 5 or 10 minutes in the camera. The resulting negative was then fixed in salt and dried. It was usually made transparent after that by being passed through a bath of molten wax. Later Fox Talbot perfected the calotype. Potassium iodide was substituted for the common salt and gallic acid added to the sensitive silver nitrate solution as well. Then the negative, having a latent image, had to be developed in silver nitrate and gallic acid. Prints were then fixed, the resulting photographs being usually of a red or brownish color.

The calotype process attained great popularity among amateurs in the 1840's and represented the first practical example of the positive-negative concept.

The Daguerreotype, for a few decades more popular than the calotype, gradually began to give way to its rival in commercial

supremacy. While calotypes were grainy and it was difficult to get the paper negatives to lie flat, the images could at least be duplicated, while each Daguerreotype was unique in itself. Refinements in the calotype eventually resulted in glass plates and, finally, the film of today. (The calotype process is somewhat similar to the modern “paper negative process.” For a description of the latter, see article on *Paper Negatives*.)

CAMERA CLUBS AND CLUB ACTIVITIES

W. F. Bent

Eastman Kodak Company, Rochester

From a study of camera clubs all over America, W. F. Bent brings you new ideas on building and maintaining a successful club. Organization procedure. Club darkroom. Photographic services. Activities. Competitions and exhibits. Publications. Club financing. Here is help in solving those ticklish problems that are bound to rise in any organization of this kind.

See Also Photographic Society of America, Royal Photographic Society

DURING the past several years there has been a marked increase in the number of amateur photographers in the United States. This has been accompanied by a corresponding increase in the number of camera clubs in all sections of the country. It is natural that those having photography

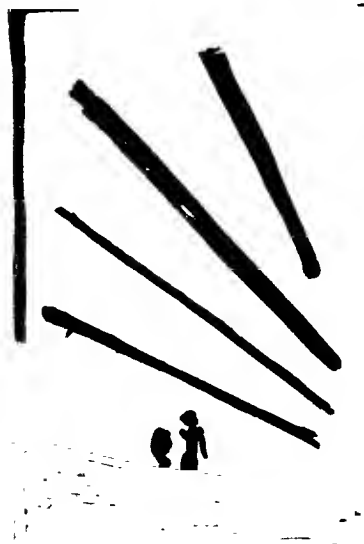
(Continued on page following insert)

COMPOSITION ANALYSIS for . . . HORIZON

To make something appear very large the best device is to show some familiar small object together with it in the same picture. We are all familiar with this method in advertising. If a manufacturer of small watches wants to show just how *small* his article is he displays the watch next to a match box, or perhaps a cigarette. The same principle can be employed to show how *large* an object is.

In the picture on this page the minute figure of the boy with his goat makes the expanse of sky above him appear immense. Notice also how the complete absence of any detail in the foreground allows the eye to be drawn up into the endless vaulted heaven. The sky in this picture isn't just a bit of plain every-day sky, but it takes on a universal aspect. It is no longer the sky of the meteorologist or the domain of the astronomer, but it becomes the heaven of the poet! Note how the particular cloud formation in this picture produces a strong illusion of perspective recession (lines running together to a point). We are all familiar with similar effects on the ground—railroad tracks, highways, etc. These strong perspective lines form a definite pattern which becomes a major part of the compositional rhythm of this picture. A slightly greater tonal gradation of the sky might have been desirable

Konrad Cramer





HORIZON

VICTOR DE PALMA

Photo of an Indian boy and a goat, taken in Arica, Chile. DATA: Rolleiflex, fast pan film, 1/100 second, f/11, orange filter



CLIFF DWELLING DETAIL

LAURA GILPIN

The detail of this Betatakin, Arizona, cliff dwelling is both interesting and beautiful. Notice that the rough texture of the house blocks is differentiated from the smooth texture of the cave wall. The use of the perpendicular lines, both of the rock and the sunlit edges of the walls, emphasizes the feeling of height. This scene has long fascinated photographers and it was particularly well photographed in the nineteenth century by T. O'Sullivan, who went out west on a government survey. See Miss Gilpin's article on Historical Architecture Photography



CLIFF DWELLING

LAURA GILPIN

The Casa Blanca in Canyon de Chelly is shown here, with the cliff dweller houses of many centuries ago literally dwarfed by the great expanse of rock into which they are built. "In composing this design, the canyon wall was purposely run out of the picture," writes the photographer. "Were the top visible, the feeling of height would be diminished. Water stain lines direct the interest to the cliff dwelling and repeat the emphasis on the high wall."

See Miss Gilpin's article on Historical Architecture Photography



PLAYMATES

ELLIOT CLARKE

It is traditionally hard to photograph babies and dogs—but the two together present a special problem. Here is an amusing contrast of the dog and child, of dark and light held together by the united attention of both on a single nearby object. DATA: 5 x 7 view camera, photoflood lights

CAMERA CLUBS AND CLUB ACTIVITIES

(Continued from page preceding insert)

as their hobby should wish to associate themselves with others who have similar interests.

As striking evidence of the magnitude of this movement there are now over 3,000 adult camera clubs in the United States. Three years ago there were less than a thousand. Another 3,000 junior camera clubs are now operating in high schools over the country. Their graduating members naturally gravitate to the adult clubs, thus affording a constant source of new members. Both groups are far from static and are constantly on the increase. Indeed a figure representing the total number of clubs in the country today would be out of date as soon as written.

Camera clubs are to be found in churches, Y. M. C. A.'s, schools, colleges, factories, labor unions, and CCC camps. Youth leaders recognize the value of photography

as a medium for giving expression to latent artistic abilities and as a promoter of greater awareness of the significance and beauty of our everyday lives. With more leisure time at its disposal than ever before the American public is turning to photography to add to the enjoyment of the "more abundant life."

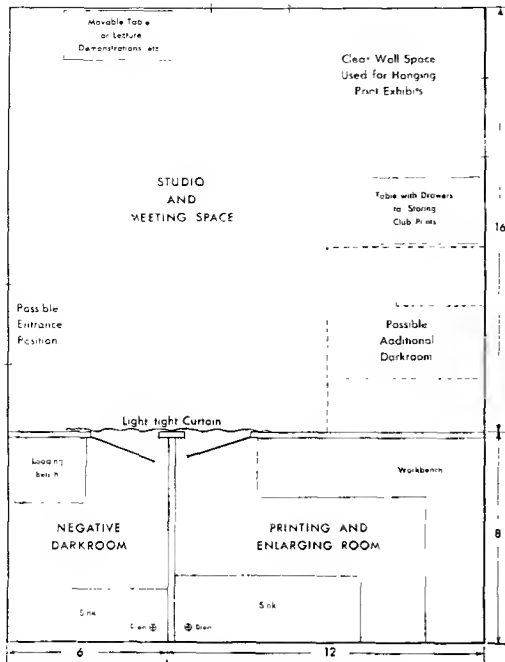
One of the world's largest camera clubs is the Kodak Camera Club of Rochester, New York, with a membership of approximately 2,500. The average number of members per adult club is 35 although some of the larger groups have 100 or more members while there are also clubs with as few as 4 to 5 members. All are making some contribution to the advancement of amateur photography.

Historically the camera club goes back to 1853 when the Photographic Society of London was organized. Later this group became known as the Royal Photographic Society. The first American club was organized in



TYPICAL CAMERA CLUB. Familiar to any camera club member is this rather crowded scene—with some trying to get exposure readings, others trying to get within shooting distance of the platform. Seated in the center are the guest experts of the evening; at far right is the club's exhibition board

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CAMERA CLUB PLAN. A small camera club might meet in a place planned something like this—with plenty of darkroom and working space, ample room for meeting. Such plans are elaborate and expensive, and may be out of the reach of most clubs. At first, it is actually best not to tie a membership down to the financial burdens which a club room would entail. A library basement, schoolroom, hotel room, or even a private home is a good beginner.

1858 in New York City. It was called the American Photographic Society.

Camera clubs have several objects: the promotion of the art and science of photography in its various branches, the association of its members for study and entertainment in matters relating to photography through exhibitions and contests, and the sponsoring of activities which will promote greater interest and betterment in the knowledge and practice of photography.

ORGANIZATION PROCEDURE

The preliminary step in forming a camera club is usually for a group of active amateur photographers to get together and lay plans for organizing. One of the early meetings is devoted to the election of officers. Most clubs choose the following officers: President, Vice President, Secretary, and Treasurer. These men then appoint the chairman of the constitution and by-laws committee and of the program committee.

At the initial meeting, the time and place of each meeting is decided upon as well as the frequency with which the club shall meet. Some clubs have regular monthly meetings at which lectures and demonstrations are given and they have separate group meetings such as the print criticism group, cinema group, etc. Again, some clubs have bi-weekly meetings, alternating lectures with print criticisms, etc.

It is usual at the second meeting to act upon the proposed constitution and by-laws. Also standing committees are usually appointed as follows: membership committee, finance committee, exhibitions committee, house committee, program committee, entertainment committee.

While the adoption of a constitution and by-laws is not a prerequisite to the establishment of a successful camera club, experience indicates that the problems and requirements of individual clubs can best be carried out within the framework of some sort of constitution.

In this connection the primary purpose or *raison d'être* for the camera club should not be forgotten. It is an association of those interested in photography. *Parliamentary procedure should be kept at a minimum.* Much of the 'business' of the club can be consummated at separate meetings of the directors and officers and if necessary later submitted to the membership as a whole for approval.

Photography is fun and full time should be allowed for its enjoyment.

A PLACE TO MEET

If possible, space is secured that will permit the proper exhibition of photographic prints and also contain room for the housing of a club library and a darkroom. In this connection, it should not be assumed that the success of a club is directly dependent upon the elaborateness of the available facilities. This is not the case. For example, a number of clubs meet alternately in members' homes. Elaborate equipment is apt to be more of a load than a blessing to the new club.

However, it is well to strive for the ultimate attainment of 'ideal' quarters. Listed here are some handy furnishings:

CAMERA CLUBS AND CLUB ACTIVITIES

1. A lounge and library, at least 15 x 20 feet
2. A studio, at least 12 x 20 to 25 feet with small intercommunicating darkroom
3. An exhibition and lecture room, 15 x 25 feet or more
4. Darkrooms for negative developing (3 to 4 small rooms) and for printing (1 or 2 rooms)
5. A locker room

A Club Darkroom Here is a suggested plan for the darkrooms and meeting space for a small camera club. This layout is naturally generalized but it will readily lend itself to adaptation to meet specific requirements. Following is a suggested list of darkroom equipment that should be acquired by the club as soon as possible:

1. At least one darkroom lamp with appropriate safelights
2. Graduates—1 dram, and 2, 4, 8, 16, and 32 oz.
3. Scales and weights
4. One dozen film developing clips
5. One dozen $3\frac{1}{4} \times 4\frac{1}{2}$ and 1 dozen 4×5 -inch film developing hangers
6. Two 4×6 and 5×7 trays and one 11×14 -inch developing and fixing tray
7. Three developing and fixing boxes—one for developing, one for fixing, and one for washing
8. One automatic tray siphon
9. One hard rubber or glass stirring rod
10. One thermometer
11. One contact printer
12. One enlarger—preferably one that will accommodate all negative sizes from miniature up to and including $4 \times 5\frac{1}{2}$

A CAMERA CLUB PHOTOGRAPHIC SERVICE

Those interested in obtaining model constitutions and by-laws may get such information in the booklet, *The Camera Club—Its Organization and Management*, published by the Photographic Society of America (Write to the secretary-treasurer, Mr. F. Quellmalz, Jr., 10 Park Avenue, New York City). Similar information, in bulletin form, is also available from the Camera Club Photographic Service, Eastman Kodak Company,

Rochester, New York. Through the medium of this service, bulletins are issued on the subjects of club organization and maintenance. Also offered is a series of prepared illustrated lectures. These talks consist of manuscripts accompanied by 2×2 -inch lantern slides in both black and white and color. In some cases they are accompanied by short demonstration reels of 16mm motion picture film and photographic prints. It is intended that individual camera club members present their own lectures using these materials as a basis.

There is no charge in connection with the Eastman Kodak Company's Camera Club Photographic Service, the only cost being that of return shipment of the slides and other illustrative materials.

Those wishing to organize movie clubs should write to the Amateur Cinema League, 420 Lexington Avenue, New York, New York. This is a non-profit organization devoted to the interests of cine workers. The monthly magazine, *Movie Makers*, is published by the League.

CAMERA CLUB ACTIVITIES

The principal camera club activities are listed as follows:

1. Monthly print competitions (black and white or monochrome) and discussions of prints
2. Monthly print exhibits
3. Color transparency and color print competitions
4. Members' annual exhibition
5. Permanent collection of prints
6. Camera hikes and outings
7. Lectures and demonstrations
8. Courses in photography
9. Open house and other social activities
10. Movies produced by the cine section
11. Special activities
12. Camera club publication
13. Publicity

Print Competitions. The competitions are arranged for by the print committee or a print director and the competing members are classified as beginners or advanced workers. Specific subjects are assigned each month with an occasional open competition when members are free to choose their own subject matter. Points are awarded in each

THE COMPLETE PHOTOGRAPHER

competition and grand awards are often given for winners compiling the most points during the whole camera club season.

It is not possible to be arbitrary in setting up this point system but roughly speaking, prints are judged on three main qualifications: artistic merit, originality, and technical excellence. The relative importance attached to these three qualifications natu-

interests do not necessarily include the making of salon prints. A more rounded group will result. Also compulsion makes work out of pleasure.

Print Exhibits. One-man exhibitions from well-known photographers and exchange exhibitions from other clubs are obtained each month. This activity is very essential to the progress of the club and its members.

Each exhibit is discussed by the members qualified to do so and on occasion outside pictorialists are invited to lead such discussions.

Several print exhibits are also available to camera clubs each year from the following sources: The American Annual Exhibition sponsored by the American Photographic Publishing Company, 353 Newbury Street, Boston, Mass.; The Camera Club, New York City; The Camera Craft Prize Contest Show sponsored by the Camera Craft Publishing Company, 425 Bush Street, San Francisco, California.

Color Section. The interest in color photography, especially with the improved Minicolor prints, is definitely on the increase with the result that many

clubs now have color sections functioning separately. The general procedure for evaluating the relative merit of black and white prints is usually followed in judging entries in the color transparency and color print competitions. Miniature transparencies are of course projected on a screen for viewing, and larger transparencies are displayed in illuminators designed to give even illumination over the whole picture area. The color prints are displayed in the same manner as black and white pictorial prints.

Annual Exhibition. The members' yearly exhibition is usually the big event of the year and is often the occasion of the annual banquet and the presentation of final prizes. A mimeographed or printed catalog is usually



MULTIPLE FLASHES. Following a flash demonstration at the Stamford Camera Club in Connecticut, these members tried their hand at flashing a few. This is an excellent idea for those who have the necessary equipment, but care must be taken to have something for the beginner to do, as well
F. P. G. Photo, A. Gordon King

rally depends upon the judges and it is safe to say that no two judges get exactly the same reaction from any particular picture. It is usual to obtain outside judges who have had experience along these lines or who are noted for their photographic work. By doing this the possibility of prejudice is nullified and also the club derives benefit from the remarks and opinions of these various authorities.

All members should be urged to participate in these competitions but no onus should be attached to those who don't. After all, enjoyment of the hobby of photography is the reason for belonging to a camera club and there should be a place in camera clubs for those whose photographic

CAMERA CLUBS AND CLUB ACTIVITIES

prepared wherein are given the names and titles of the exhibit prints, the names of the makers, and the prize winners. A jury of selection and awards is charged with deciding the procedure for selecting the prints and the method of hanging. As with the monthly print competitions, a beginners' and an advanced class are set up. This is most important as otherwise the learners might be discouraged from participating in subsequent exhibits or competitions. Sometimes prints are also classified as to subject matter—landscapes, portraits, seascapes, etc.

Permanent Print Collection As a stimulus to better work, the permanent print collection is a project that is undertaken by many clubs. A committee usually obtains outstanding pictorial photographs for such a collection—often secured from visiting exhibitions. Most pictorialists are willing to sell

their photographs at a reasonable price for such a purpose. Sometimes the desired photographs are first seen as reproductions in magazines. Here, in writing to the maker, mention is made of the name of the publication in which the picture appeared.

Club Outings Camera hikes afford splendid opportunities for the members to enjoy a pleasant outing and at the same time secure pictures at places of local interest under the guidance of advanced workers. Often a contest is held in connection with the outing, suitable prizes being awarded to the winner. Here again, beginners and advanced workers do not compete with one another. Refreshments are usually brought along.

Lectures and Demonstrations. The program committee has charge of securing lectures and demonstrations. Such programs are usually provided by local people al-



MASS SHOOTING. On camera club excursions, where some fifty people all have cameras, tripods, cases, accessories galore, considerable organization is in order. This shows an instructor pointing out some of photographic possibilities of the scene
F. P. G. Photo, Herbert Radisch

though occasionally it may be possible to procure speakers from further away. In such cases it is customary to pay railroad and hotel expenses. Sometimes speakers are obtained from local dealers or photographers. Then, too, photographic manufacturers are occasionally able to provide lecturers and demonstrations.

In addition to the regular camera club lecture services, 16mm motion picture films can be obtained from Educational Screen, Inc., 64 E. Lake Street, Chicago, Illinois, and from the United States Films Service, Washington, D. C.

Courses in Photography A photographic course is very important to the progress of the camera club. Whether the course is for beginners or advanced workers depends naturally upon the photographic experience of the majority of the members. In any case, 10 to 12 two-hour periods are normally sufficient to cover the ground adequately. Average fees range from \$5.00 to \$10.00.

Clubs should not incur great expense by making the course too elaborate, as this often results in a beclouding of the fundamentals. It is most important that each student put into actual practice the information given and also that examples of each student's work are brought in for discussion. One lecture demonstration per week is the best procedure as this allows time for the assimilation of information given and for the carrying out of the assignments. Two textbooks are recommended: for the beginner's course, *Elementary Photography* by C. B. Neblette, Frederick W. Brehm, and Everett L. Priest; for an advanced course, *Photography, Principles and Practice* by C. B. Neblette. Bulletin No. 14 of the Camera Club Photographic Service contains an outline of a beginner's course embodying the fundamentals and a set of practical assignments for the students is given.

A properly publicized course in photography can be the means of procuring new club members and the resultant revenue from increased dues, etc., helps further to make this activity self supporting.

Social Activities Most camera clubs have at least one Open House night. This is a social event and it is usual to provide some

sort of entertainment and also refreshments. Sometimes Open House is held on the occasion of the first showing of the annual members' exhibition. There are other social functions that can easily be arranged such as "swap nights" where prints or various items of photographic equipment are exchanged.

Movie Section. Many still camera clubs have motion picture sections. This group could produce a screen play as a joint effort. Some members are designated as scenario writers, others as cameramen, directors, prop men, actors, etc. Also subjects of special interest to individual members often form the basis for interesting motion picture shorts. Films are projected at meetings and constructive criticism is given.

Special Activities There are many special activities that are too often overlooked. The camera club can become an important factor in community life—not only by presenting to the public worthwhile photographic salons but also by assisting with important social projects. For example, most towns conduct yearly campaigns to relieve human suffering by raising funds for hospitals, homes for the aged, character building agencies, etc. Here is a chance for the camera club to step in, to picture the conditions to be ameliorated, to show the fine work being done by the agencies concerned.

Similar opportunities are presented by community efforts to beautify the town, to improve housing conditions, or improve roads that represent traffic hazards. Here again is important work for the wide awake camera club—a task worthy of the talents of camera club members.

Again there are many events of local interest to be recorded by the camera. Many towns have annual flower festivals, rodeos, beauty pageants, homecoming weeks, etc. Good pictures of these important civic affairs can be used to advertise the city and for promoting the events themselves. It seems to this writer that for the most part camera clubs have failed to realize the important role they can play in community life. Here are opportunities that should not be missed.

Club Publications. Many camera clubs issue bulletins or magazines at regular inter-

CAMERA CLUBS AND CLUB ACTIVITIES

vals. These publications range from mimeographed sheets to letterpress periodicals with halftone reproductions. All, however, perform a very important job in helping to promote and maintain interest in the camera club. In this connection it seems to the writer that the primary function of the club magazine should be to tell club members of forthcoming programs, announce competitions, prize awards, etc. In other

words no effort should be made to compete with the national photographic publications. This, of course, does not mean that members cannot report darkroom hints or useful photographic gadgets—but let the national magazines take care of the more serious articles on photography.

Sample club bulletins can be obtained from other camera clubs and if letterpress or offset printing is contemplated your



CAMERA CLUB EXCURSION. Camera clubs can be fun—especially if you have models like these to pose for you. Models will often have to be hired, but if the standard of feminine pulchritude in the club is high—why bother?

F. P. G. Photo, Victor De Palma

local printer will be glad to help and advise you.

Publicity. Camera clubs should not be afraid to publicize themselves. Good publicity never hurt any club. In this connec-

Also photographic dealers are often willing to display cards announcing forthcoming meetings and sometimes are glad to show prize winning pictures in their windows. The dealer benefits from the interest aroused by an interesting exhibit and the club gains increased recognition.

Some camera clubs extend their publicity efforts to the radio. Interesting photographic topics are broadcast, prominent personages are interviewed, announcements are made, etc. Of course radio work requires a special technic but it is mentioned here as just one more example of what can be done in publicizing your club.

CAMERA CLUB COUNCILS

A recent development is the formation of camera club councils. These organizations are made up of area camera clubs who band together for the purpose of mass activities such as lectures, salons, etc. Each member club is represented on the council committee. Among such councils are the Associated Camera Clubs of Chicago, the Chicago Park District Camera Club Council, the Cincinnati Camera Council, the Metropolitan Camera Club Council, the New England

Camera Club Council, the Niagara Frontier Camera Club Council, the Philadelphia Council of Camera Clubs, the St. Louis Camera Club Council, the Southern California Council of Camera Clubs, and the Washington Camera Council. There are many advantages to be obtained from membership in a council especially for some of the smaller clubs who otherwise would not be in a position to obtain outstanding programs, etc. Then, too, an interchange of



CANDID CAMERA NIGHT. And the audience makes a good subject too, as well as the hired models. The variety of cameras shown in operation include miniatures, with and without special lenses, folding cameras, and even a motion picture camera

tion newspaper editors are usually willing to carry stories about outstanding club events such as the visit of an important speaker, the yearly prize winners, the annual banquet, etc. Often rotogravure editors are pleased to reproduce outstanding pictorial photographs. Then, too, some camera clubs conduct camera departments in local newspapers. Here readers' questions are answered, photographs are reproduced and analyzed, club events announced, etc.

THE CAMERA GUN

ideas among area camera clubs is often extremely profitable.

CLUB FINANCING

The expenses in operating a camera club, of course, vary greatly from club to club and only generalities can here be included. However, the following items represent all the expenses likely to be encountered. Naturally, many groups do not have to cope with all the costs listed.

1. Printing
 - a. Stationery
 - b. Letters to members
 - c. Forms, application blanks, membership cards, exhibition labels, notices of meetings, etc.
 - d. Periodic bulletin or magazine (May be partially financed by advertising.)
2. Express and Mailing
 - a. Ordinary correspondence
 - b. Letters and bulletins to members
 - c. Express and postage on print exhibits
3. Lectures
 - a. Sometimes the expenses of visiting lecturers have to be paid.
4. Studio and Darkroom Supplies and Expenses
 - a. Cost of chemicals and paper
 - b. Repairs of furniture and equipment
 - c. Replacement of equipment
5. Exhibitions and Salons
 - a. Printing and mailing entry blanks
 - b. Expense of judges
 - c. Prizes
 - d. Display boards, glass, lights, etc.
 - e. Catalogs, printing, and mailing
 - f. Exhibition stickers
 - g. Express and postage on prints
6. Insurance
 - a. Fire insurance
 - b. Burglary insurance
 - c. Liability insurance
7. Administrative Expenses
 - a. Dues to photographic societies
 - b. Subscriptions to magazines, books, etc.
 - c. Purchase of prints for permanent collection
 - d. Salary of janitor

e. Rent, upkeep

f. Miscellaneous

Camera clubs are able to meet these expenses and even to maintain a reasonable treasury balance because the income of these clubs can be derived from the following sources:

1. Initiation or membership fee
2. Dues
3. Contributions from sustaining members
4. Fees for photographic instruction
5. Fees from lecture courses
6. Sales of pictures and services
7. Prize money received by the club or its members
8. Income from investments

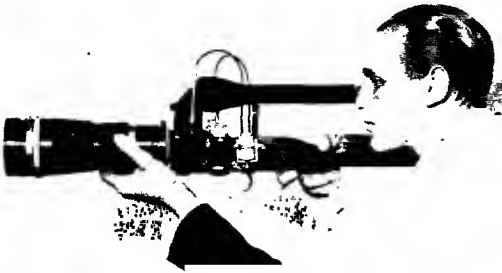
THE CAMERA GUN. A camera gun is, simply, a camera built to resemble a gun and to duplicate a gun's ease and accuracy of handling. In the nineteenth century when photography was new, many photographers wished to hide their activities from over-suspicious or too-curious people. Cameras were made to resemble bags, hats, watches, even buttons. One bright soul invented a camera which looked like a gun and was operated by a trigger. While it only tended to draw terrified attention to the photographer's activities, the idea has lived on today in two types of camera guns, built for serious and not surreptitious purposes. These are the hand camera gun and the air-plane gunner training camera.



CONTAX CAMERA GUN. Similar to the original camera gun used at the 1936 Olympic Games, this Contax has a Zeiss $7\frac{1}{2}$ -inch lens attached. The general design is different from the Leica camera gun, particularly in the length of the focusing eyepiece. The basic idea, however, is similar

THE COMPLETE PHOTOGRAPHER

Hand Camera Gun. For persons who make frequent use of a telephoto or other long focus lenses and who want to be free of a tripod, the hand camera gun is perfect. This new method of accurate and fast aiming of a telephoto set-up was first perfected at the Berlin Olympic Games of 1936. The gun was necessitated by the introduction of a Zeiss lens of $7\frac{1}{2}$ -inch focal length and of a very great aperture, $f/2.8$. Its use made cumbersome Big Bertha cameras unneces-

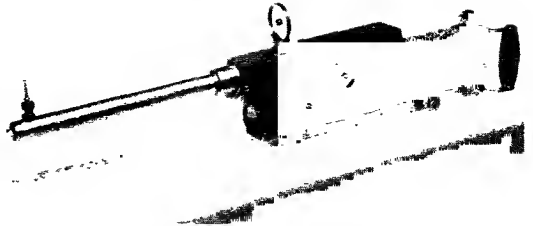


LEICA CAMERA GUN. This camera is shown with a 400mm Telyt lens. Notice that the camera gun is held exactly like a real gun to insure greater steadiness. Focusing is done with the left hand, while the right hand operates the two triggers—the forward one for winding the film, the rear one for making the exposure

sary in such fast-moving sports as racing, running, swimming, etc.

The camera gun is useful not only for sports, but also for bird photography, animal photography, news photography—or in any field where long focus lenses require accuracy coupled with portability. Home-made set-ups can and have been made which combine the features of the regular rifle gun stock, sight, and trigger with the camera and lens. Some of these have been simple arrangements in the form of a pistol—and these are useful for one-hand operation when in a crowd or when the other hand is holding a flashgun. The rifle type is the most satisfactory and good commercial models are made for such cameras as the Contax and Leica.

The Leica camera gun is built to accommodate either the 135mm, 200mm, or 400mm lens. The accompanying illustration shows this gun in operation with the long 400mm Telyt lens. Focusing is done with the left hand on the milled lens portion; the long perescopic arrangement which comes

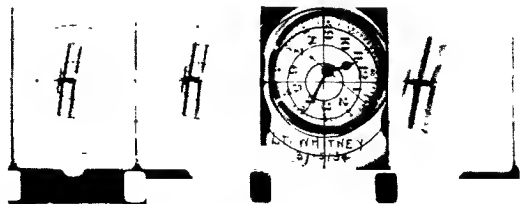


FAIRCHILD CG-16. This is built to simulate the operation of a real machine gun and can be put on a swing-mount or fixed to the wing. Exposure, on this, is made with a thumb trigger

conveniently close to the eye is both view finder and focuser. By a series of mirrors the image, which is formed on the ground-glass of the mirror reflex housing (located just behind the left hand), is corrected for horizontal and vertical position and may be viewed through the perescopic barrel in proper focus and parallax.

On the camera gun are two triggers. The forward one is for rapid winding and is connected with the camera spool through a special baseplate by a cable. The rear trigger—usually operated with the middle finger—moves the mirror of the reflex housing out of the way and makes the exposure, also by cable release.

Camera Machine Guns The camera machine gun, when mounted on and operated from an airplane, makes photographic records while simulating the firing of an actual gun. Its main purpose is to train aircraft fighters in the art of gunnery under combat conditions—without the danger of using real bullets. Of course, in war time it is used, in synchronization with real machine guns, to make an official photographic record of hits.

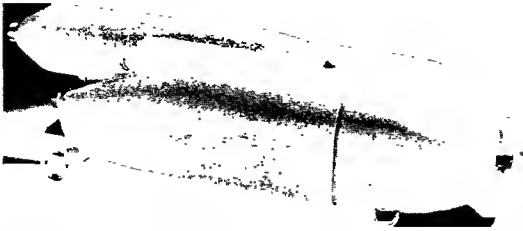


DIRECT HIT. A strip of film showing a direct hit. Notice the clock and the handwritten data which were photographed between bursts. The strip indicates that the top burst lasted $6\frac{1}{2}$ seconds (see the second hand); there was then a pause until the opposing plane got into the line of "fire", when the trigger was again pulled—and a direct hit scored

CAMERA LUCIDA

The idea of the camera gun for airplanes got its start at the time of World War I, when the British developed a camera which shot single pictures. The Lewis camera gun was widely used then.

When motion picture lenses, films, and shutters were improved, the movie gun was possible. Today's camera guns are all of this type and among these is England's Williamson Cine Gun Camera with a 2-inch, $f/3.5$ lens shooting 10 to 16 exposures on 16mm film per second. In the United States, research into the cine machine gun was made by Captain A. E. Nesbitt and the principal maker of guns based on his theories is Fairchild—with the Fairchild CG-16 and the Fairchild W-7.



FAIRCHILD W-7. Although looking very much like a bomb, this is a camera gun—the kind used for rigid mounting on an airplane wing. It is run by a solenoid remote control and is streamlined to cut down air resistance. This gun is not manually operated by the student and therefore does not have to work or look like a machine gun.

The Fairchild CG-16 copies in almost every way possible the design of the regulation Browning and Colt machine guns used in actual combat. The idea is to give gunners practical training not only in aiming under difficult conditions but in handling the real instrument instinctively. Therefore the camera gun has a long barrel with ring-and-bead sight, magazine loading, thumb trigger, cocking handle, and flexible mount. The camera is fixed for focus from 25 feet to infinity. Therefore the only photographic adjustment to make is that of diaphragm opening (lens is $f/3$ to $f/16$)—and that can be done before taking off. A Minus-blue filter can also be put on before take-off.

The CG-16 may be put on a swing-mount or fixed to the wing, depending on whether it is to be used for a pursuit or bomber plane. It carries, in magazine form, 25 feet of 16mm film, shot at either 12 or 16 ex-

posures per second. Extra speed panchromatic film is almost invariably used.

The exposure is made by the thumb trigger or by remote control through a solenoid. Each exposure is made through a glass plate engraved with cross lines and concentric circles, the plate being located between the rotary disc shutter and the focal plane. This shows the "direct hits" when the "enemy" plane is caught in the exact center of the field. At the end of each burst of fire or series of exposures, a record of the time and the flight is automatically made. The watch has an hour hand which tells the time of day and a stop watch second hand which indicates the duration of the burst; the data card has the date and gunner's name written on it. And the image of these is projected by prisms onto the film at the proper time.

The Fairchild W-7, while similar to the CG-16 in basic construction, does not resemble a gun in any way and does not need to, since it is never actually handled by gunners. This stationary, wing-attached camera gun is operated by the solenoid remote control, as are the real guns of this type.

Film from these aerial camera guns, when viewed by projector, can be very useful by pointing out early or late firing, drags, and other gunnery faults. They can be used to locate the "blind spots" of other planes and the images are excellent also for showing the maneuver skill of the "enemy" pilot.

CAMERA LUCIDA. An ingenious adaptation of an optical prism, the camera lucida was invented in 1825 by Dr. W. H. Wollaston (1766—1826). It was used, prior to the advent of photography, as an aid in tracing on paper the outlines of near or distant scenes or objects. This prism or arrangement of mirrors causes an apparent image to appear, as if projected, upon a plane surface—where it can be traced. It is unlike the camera obscura, as the latter actually does project an image onto the tracing surface. The "Lucy" used by present-day commercial artists is a direct descendant of the camera lucida.

Fox Talbot's unsuccessful attempts, in 1833, to make a pencil record of Italian

scenery with one of Wollaston's instruments led him to similar trials with translucent paper fastened over the glass viewing screen of a portable camera obscura. And those studies of means for permanently fixing the images he saw on the paper led to his invention of the photographic calotype process.

Despite Fox Talbot's failure with the camera lucida, others were more successful and several books were published between 1828 and 1840 with illustrations "from sketches made with the Camera Lucida." One of the most interesting is a collection of forty etchings of North American scenes from sketches made by Captain Basil Hall in 1827 and 1828. With the camera lucida this author-artist sketched the exact appearance of the Horse Shoe and American Falls at Niagara, and so provided a record of great interest to geologists studying the slow progress of erosion caused by the Niagara River.—*A. E. Marshall.*

CAMERA JOURNALISM

Edward Stanley

*Writer, Former Executive News Photo Editor,
Associated Press*

Photographic journalists everywhere—news-paper and syndicate staffmen as well as free lancers—will want to know the facts told in this article on one of the newest forms of journalism and one of the biggest fields of photography. The history of photo-journalism, the transmission of news photos, sources of and markets for news shots, the requirements of news photography, news reels and their uses, the future trends of photo-journalism—these are the vital subjects here discussed.

See Also Newspaper Photography, Picture Series, Selling Photographs to Newspapers

PHOTO-JOURNALISM is easily the most robust and spectacular of all the new developments in modern journalism. As a technic for imparting information, it is less than 50 years old, and only within the last few years has it achieved anything like adult standing in the profession generally.

The business got a bad name at the outset, and for two or three decades labored under the social disadvantage of being associated almost exclusively with the more lurid type of crime and its sensational presentation. It was, indeed, the under-privileged child of

the press. Now it is a dignified and important part of the daily and periodical press, and the sums spent for merely the collection and distribution of news photographs run into millions of dollars yearly.

NEWS THROUGH PICTURES

New as it is, however, its basic foundations go back to the beginnings of civilized society, which doubtless accounts for the universal appeal of news told pictorially. Primitive peoples used, and still use, pictures and other graphic forms to convey information. Hogarth, Daumier, and Goya certainly operated as great journalists in the pictorial medium, as well as great artists, before the camera was invented. And many of us are familiar with the use of lightning sketch artists in the days before the invention of the halftone engraving. In fact, even after the halftone dot had made its appearance in newspapers, such artists still were used because the technical limitations of early cameras were so severe, the equipment so bulky, the process of making a print so slow, and the results so uncertain and uneven. It is not unreasonable to say that the technic of pictorial representation of the news is as old as man's desire to inform others and his ability to draw a picture to do it. It has certainly been fathered by the historical procession of great artists and the modern camera is merely a more efficient device for doing what they did, but doing it faster and for more people.

Improvement in the type of equipment available for press photography was barely perceptible until after the turn of the century. Then the whole field of photography was swept along in the great advances made in the technic of scientific research and discovery. Lenses grew better, plates faster, and the operating mechanics and the size of the camera itself became more adaptable to journalistic needs. Even these advances, great as they were, seem small now. Many an able news photographer can remember the days when he used flash powder, was fortunate if he and the subject both weren't burned, and had to work with almost supernatural speed if he got a second shot before billows of yellow smoke made further photography impracticable.

CAMERA JOURNALISM

During the last decade the improvement in press camera equipment has been tremendous. The machines are small, strong, designed especially for the work; the lenses are fast, varied in type. Even the flashbulb which once seemed miraculous now looks cumbersome beside the "peanut" bulbs in general use. In fact, many types of cameras are now used—reflex, candid, magic eye, long lens jobs—all of which are built specifically to meet the exacting requirements of today's professional press photographers.

Despite the magnificent documentation of the Civil War by the great photographer Brady, and even a few photographs made of our war with Mexico, and some brilliant pictorialists in the magazine field, the possibilities of the photograph as a reporting instrument were virtually ignored in the newspaper field until the World War. From that time on progress has been steady, with a tremendous leap forward in 1935 when practicable means of transmitting photographs by wire were devised.

BEGINNINGS OF NEWS PHOTOGRAPHY

In terms of the modern newspaper, the circulation building possibilities of pictorial material were first recognized by Joseph Pulitzer. He brought the first pictures into a modern newspaper six months after he acquired the old *New York World*. He had only woodcuts to offer but the circulation spurted, nevertheless. On the day of Grant's funeral, Pulitzer sold 250,000 newspapers, then a record. That was in 1885.

In 1880, Stephen Horgan's halftone process was perfected and used for the first time—with the appearance on March 4 in *The New York Daily Graphic* of the now-famous "Shantytown Scene." All newspapers began reproducing photographs. By 1897 the circulation of *The Sunday World*,

which was crammed with pictures, had risen to 600,000. Pulitzer, incidentally, originated the X-marks-the-spot technic which is with us still. The X is now supplanted by arrows or circles.

Pulitzer was joined in battle by Hearst in the use of pictures, and during the Spanish-American war the competition between these two was terrific. Hearst once astounded conservative publishers by chartering a special train to rush the Jeffries-Johnson fight pictures from Carson City,



HISTORIC CONFERENCE. Somewhere at sea, the heads of two governments met and conferred. This photo shows President Roosevelt and Prime Minister Churchill talking while on board H. M. S. *Prince of Wales*, August 10, 1941. Such a photo is important not only as a news shot, but also for governmental use, as it proves beyond a doubt that the meeting, shrouded in mystery, actually did take place

Photo, Acme

Nevada to San Francisco. The Hearst newspapers, from their inception, have been outstanding in the use of pictures.

In the early part of the century photo-electric engraving became available and newspapers sent the woodcuts to the junk heap forever. Photographers began to bring in the first crude news pictures.

With this development came the demand for speed and still more speed. Trains or fast horses were sometimes employed in relays to rush pictures to newspapers from long distances. There were no alert syndicates then providing picture coverage. The first picture syndicates came in the early

1900's—Bain's, which was chiefly concerned with events in and near New York, then American Press, followed by Underwood and Underwood and others.

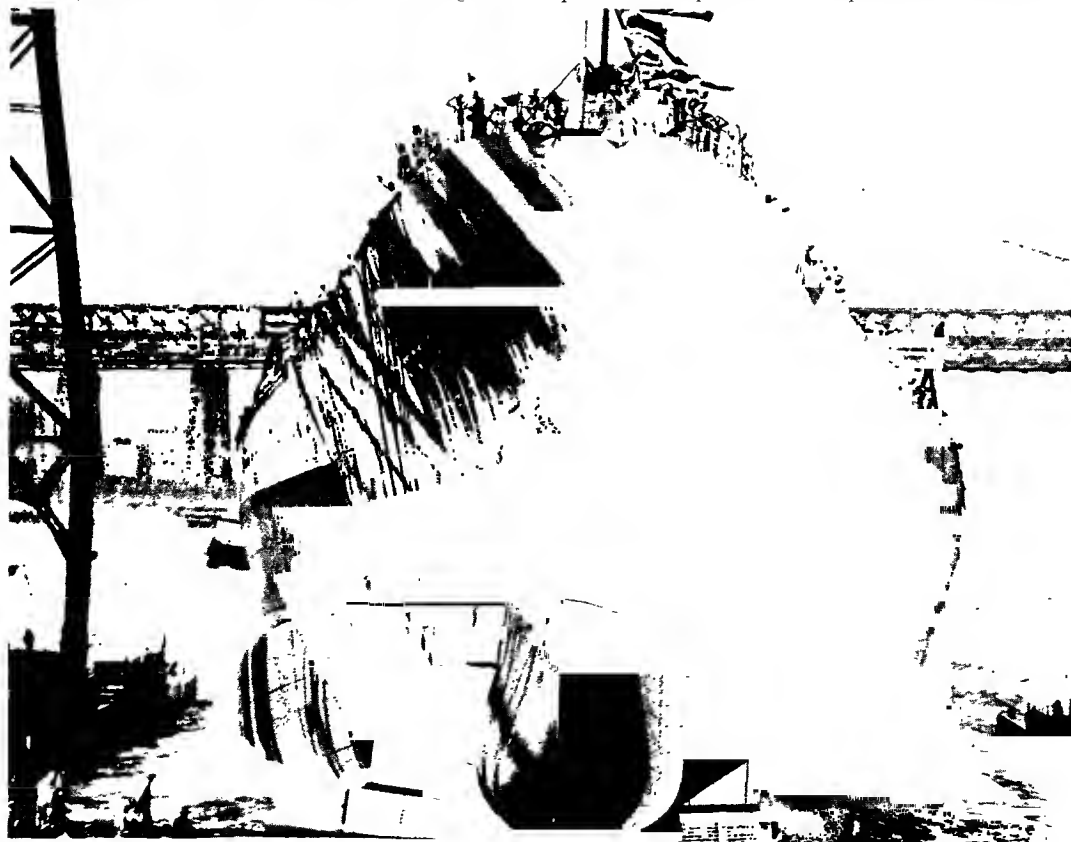
In 1913 the late Adolph Ochs, publisher of *The New York Times*, investigated the development of the rotogravure press while abroad, and ordered two to be shipped to this country. Early the following year the first rotogravure supplement in the United States made its appearance in *The New York Times*. A gain of 100,000 in circulation was reported. *The Times'* success led to the introduction of gravure supplements in most metropolitan newspapers in America, a distinctive American characteristic.

THE TABLOID

During World War I pictures generally came into wider use, but never in this country equalling their prominence in England.

There Lord Northcliffe had established *The London Mirror*, the world's first illustrated tabloid daily, and probably the greatest single spur news photography has ever had. Northcliffe, influenced by the success of the pictorial weeklies in England, set up a staff of photographers who were assigned like reporters, and engaged photographer-journalists as correspondents in all parts of the world.

In June of 1919, *The Illustrated Daily News* was established in New York, and at first seemed intended as a feature and sports publication. Its content changed as experience was gained, and the appeal broadened. While *The News* was somewhat more gaudy during its first years than it is now, its circulation is the greatest in America and its pictorial news coverage is wide. By and large, however, *The News* seems to have passed its period of exploration with the

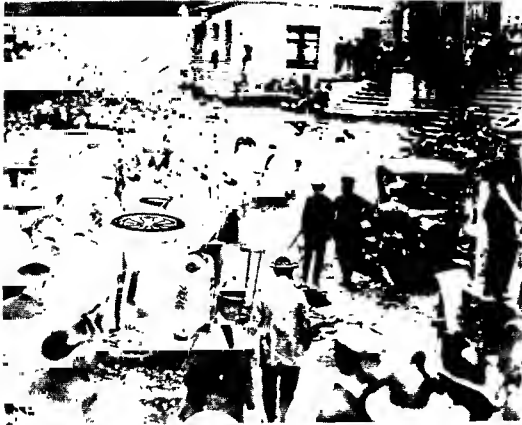


DUNKING A DREADNAUGHT. This prize winner at a Press Photographers' Exhibit shows the 35,000-ton battleship North Carolina being launched at the navy yard in Brooklyn. Taken with a Big Bertha camera—because the press and spectators were barred from too close an inspection—this shot is a wonderful close-up of the massive boat. See article on Big Bertha Cameras
Photo, Mike Ackerman of Acme

CAMERA JOURNALISM

pictorial form, and in that respect offers few surprises.

The success of *The Daily News* boomed the news picture as a powerful circulation builder, and picture tabloids sprang up in all parts of the country. Some were successful. Other newspapers built their own photoengraving plants, subscribed to one of



WALL STREET BOMBING. In 1920 a bomb was placed in front of the Treasury Building at Wall Street. This shows the general scene of the explosion—taken only a very few minutes afterwards. Excellent spot news photography for its day
INP Photo, Vincent Palumbo

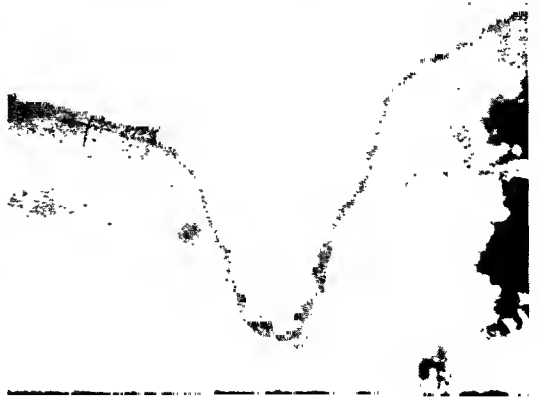
the larger picture syndicates, hired staff photographers, built darkrooms, and bought equipment. Speed became the keyword, and competition was keen.

SPEED—THE KEYWORD

Newspapers usually employed their own staff of cameramen for local news; the syndicates opened bureaus in the key cities, with staff photographers on the job from coast to coast. Able free lance photographers in the smaller cities and outlying districts were encouraged by the syndicates to send in their material.

Hundreds of the smaller dailies, weeklies, and semi-weeklies contracted for the mat services which were built up by the syndicates. For a nominal price, the picture page, in matrix form, would be received by the smaller newspaper, all prepared and ready for casting. Cables and wires were speeding the news; ships, trains, and planes were bringing the pictures. Chartering planes to expedite the news picture became the everyday occurrence; with the first airmail, the big

syndicates turned to planes to get the first picture in on a big story.



TORNADO. In Lincolnvile, Kansas, one August day this tornado roared through and left a trail of devastation. On such occasions, camera journalism must depend largely upon amateur photographers for coverage. The shots of the writhing funnel-shaped wind column were taken by Mrs. Omar Shields, local resident. The top photo shows the tornado 3 miles away; the second, as it swept through Lincolnvile; the third shot shows the twister, $\frac{1}{2}$ mile away, as it was disintegrating

Photos, Mrs. Omar Shield



FAITHFUL DOG. Guarding his master is this dog—making a perfect combination of the accident and the human interest story. Chester Brooks lies injured beside his wrecked car on the Jericho Turnpike in Long Island. It was necessary to blindfold the dog, Fritz, to keep him from following the ambulance
INP Photo, John Drennan

As speed became more essential, experiments were being conducted in many quarters to transmit pictures by wire, utilizing the existing telephone and telegraph wires. In 1921 *The New York World* successfully transmitted the picture of an Indian head to *The St. Louis Post-Dispatch* using a telephone circuit. In 1923, the first telegraphed pictures of the Japanese earthquake were sent from Seattle to Los Angeles, Chicago, and New York. The following year, the American Telephone and Telegraph Company sent pictures of the Republican convention in Cleveland in a test of telephone wire transmission. In December of the same year, RCA gave a public demonstration of picture transmission by radio from England to America. Likewise in Europe, wired transmission of pictures was taking a firm hold.

In New York two inventors working for a picture syndicate invented a process called Telepix, and on New Year's Day of 1925, they successfully sent a picture of the Rose Bowl football game in Los Angeles to New York and Chicago simultaneously over the Western Union wires. This system reduced the image to telegraphic dots and dashes which were sent over the telegraphic wire and then retranslated to the original picture at the receiving end.

Though Telepix was syndicated to quite a number of large cities, A. T. & T. carried on

its experiments using a photoelectric cell to translate light and shadows of pictures into sound impulses over the telephone lines, and then reconverted into light beams. In a test on March 4, 1925, pictures were transmitted from Washington to New York and San Francisco. The powerful A. T. & T. added cities to its list, opening its commercial service to the public on April 4, 1925. It charged \$50 for a 5 x 7 transmission from New York to Chicago; \$100 from New York to San Francisco.

Boston was added in November of the same year and later Cleveland and Atlanta. Telepix grew for a while, then languished. Facsimile was winning out over the dot and dash method of transmission. Telephoto, as the A. T. & T. system was called, remained in existence for several years, but its results were not too happy and the service was first curtailed and then abandoned while the idea underwent further laboratory research.

As briefly mentioned above, December, 1924 was another important date in the history of news photography. RCA opened its New York offices to the public for a demonstration of a small machine which was able to receive a picture transmitted through the ether across the Atlantic from its offices in Marconi House in London. In less than two years, Captain R. H. Ranger, an RCA engineer, had developed this remarkable



WAITING FOR THE PRESIDENT. Camera journalism is often capable of subtle humor, of which this is an excellent example. This photograph was taken outside of the Capitol Building as President Roosevelt was delivering an address before Congress. Shown on the presidential car top are the hat and coat of the President; on the trunk are the hats of James Roosevelt, Stephen Early, and Marvin MacIntyre. The President's chauffeur is shown looking on. A posed picture—but a good one
Photo, Acme

CAMERA JOURNALISM

piece of apparatus—a machine to send pictures by radio!

The first spot news picture that was ordered and received by a syndicate in this country was transmitted from London to New York on March 5, 1925, and showed the body of President Ebert of Germany lying in state. It took only 25 minutes for the actual transmission of the picture. Five days later, the original of the same photograph reached New York on the *Aquitania*!

RCA has continued perfecting this machine, and while results still often leave much to be desired, there has been a tremendous improvement over the first transmission which sometimes more closely resembled diagrams than photographs.

WIREFOTO NETWORKS

While all this was going on the quality of news photographs themselves had improved sharply, both the mechanical and the editorial quality. With the increased demand for news pictures, photographers and their editors began to explore new fields, and picture reporting flourished on the more varied diet. As the pictures improved, so did their timeliness, and the possibilities of transmitting by wire a full news report composed entirely of photographs became only a matter of time. In fact, Kent Cooper, the aggressive general manager of The Associated Press, had predicted to his Board of Directors in 1924 that one day they would transmit news pictures over a great network, side by side with the text report.

Cooper, always an innovator, had followed the first experiments with fascinated interest, and when the Bell laboratories exhibited to him in 1934 some almost perfect prints received over their new machines he determined to set up a network for The Associated Press.

The details accomplished, the A.P.'s Wirephoto network began operation on New Year's Day, 1935. It comprised 10,000 miles of high fidelity wire and had receiving and sending stations in 24 leading cities. The first picture transmitted was of an airplane accident in the Adirondacks. Many improvements have followed the orig-



WRECK. On June 20, 1938 this crack western train wrecked in Miles City, Montana. Speeding across a flood-weakened trestle, it plunged into Custer Creek, killing scores. This remarkable general view airplane photograph shows the swollen and muddy river, the wrecked trestle, the submerged cars. Notice the "accordion-pleat" angle of the cars, indicating the terrific impact

International News Photo

inal set—the machines are smaller, less expensive to build or to operate, small portable transmitters are commonplace, and the participating memberships increased.

Other services quickly followed the Associated Press. International News Photos, Acme, and Times Wide-World each developed its own system. Under Charles M. Graves, Wide World Photos (then a subsidiary of *The New York Times*) fathered the development of light, portable transmitters which did not require a network wire for operation and thus were less expensive in respect to transmission costs. These machines (as well as the A.P.'s) have been adapted to radio transmission, and their most spectacular use in this capacity has been the transmission of pictures from Byrd's Camp in the Antarctic to New York.

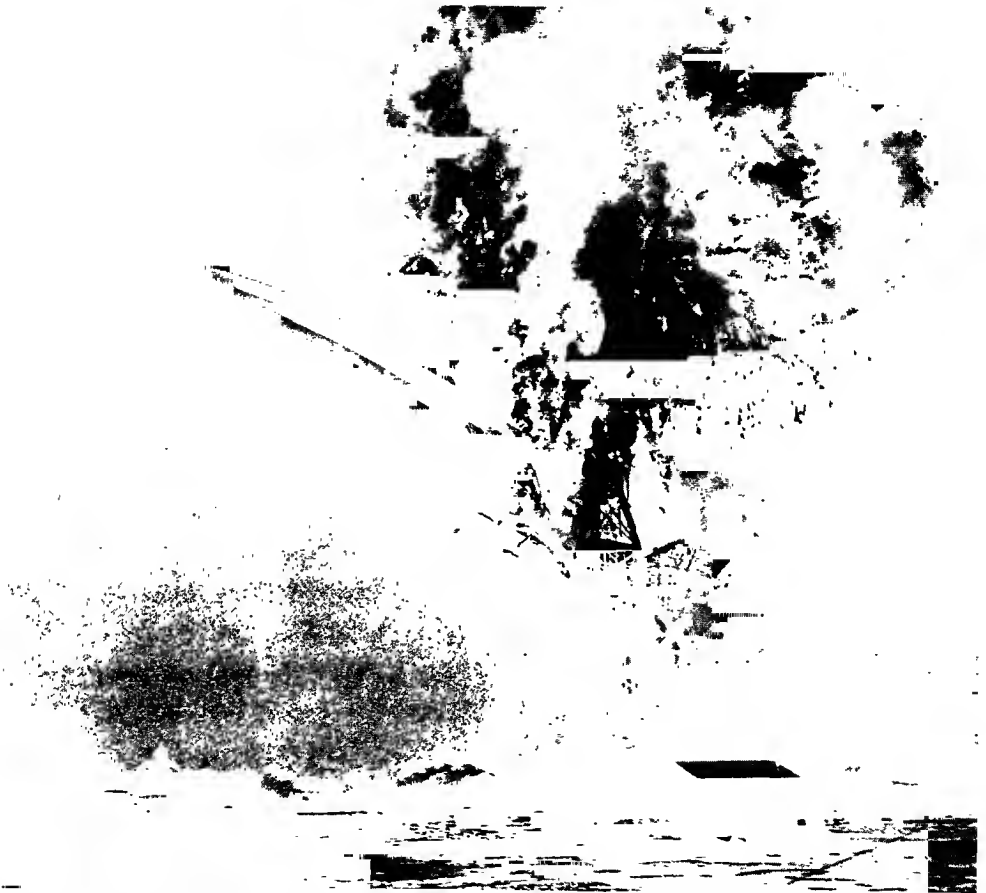
THE COMPLETE PHOTOGRAPHER

The technical advance which has made it possible for pictures of news events to flash across the continent has counted more than any single factor in making photo-news reporting a major interest of American newspapers. It logically follows that the greatest source of news in picture form are today, and will continue to be, the organizations which distribute newsphotos by wire. These organizations, of which there are four, are all either part of or closely allied with great news organizations.

They have heavy support from their subscribers and have access to funds to meet any emergency. None of these great agencies—The Associated Press News Photo Service, Acme Newspictures (Scripps-Howard), International News Photos (Hearst), or Wide World (New York Times)—confines its activities to the transmission

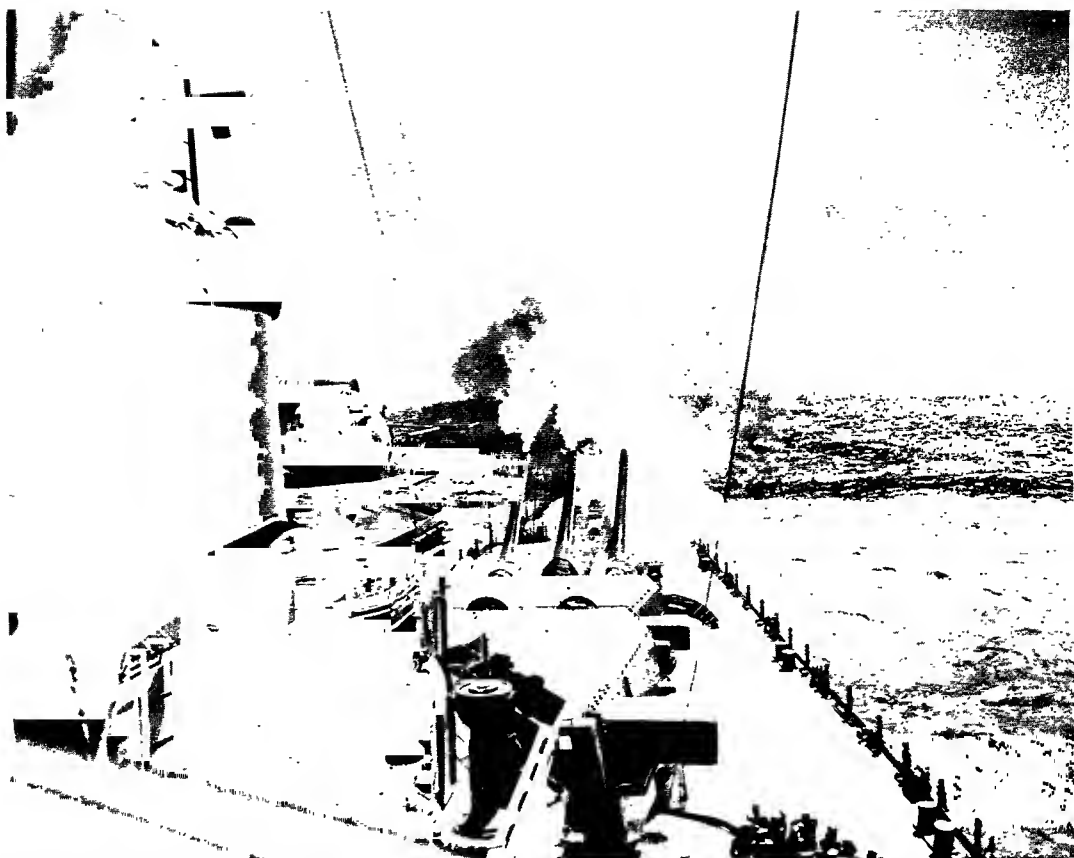
of photos by wire. All service prints by mail and in addition matrices by mail. Some, notably the A.P., have auxiliary points at which mats of wired pictures are made and distributed to smaller newspapers which cannot afford the more expensive print service.

A typical agency will have bureaus, with editors, managers, and varying numbers of photographers located at strategic points over this country, and abroad as well. The Associated Press, to take an example with which the writer is familiar, maintains newsphoto bureaus in about 20 cities. In addition the services of photographers employed by member newspapers are available to the service, and there are the usual arrangements with free lance photographic correspondents in all parts of the country. In many states the agency has at least one



END OF THE HINDENBERG. When photographers and sightseers had gathered at Lakehurst, N. J. one day in 1937 to see the arrival of Germany's great zeppelin, one of the most spectacular news events of all time was enacted before them. Many shots were taken of the disaster, of which this is perhaps the best and most famous

INP Photo, Sam Shere



U. S. S. NORTH CAROLINA. At sea, the North Carolina tries out her guns for the first time. This photo was made from an anti-aircraft pom-pom emplacement and shows the exact moment of firing. Notice the tense attitudes of all the men shown
Photo, Wide World

such "stringer" in every county seat. Thus the photographic resources upon which the service can call in event of emergency in any part of the country run into the thousands of men and women. In addition, the A.P. operates two foreign subsidiaries which collect and distribute its pictures abroad.

FREE LANCERS

Staff photographers in the field, or operating from the head office, bear the brunt of the assignments. They are perhaps more responsive to editorial direction than are free lancers, and they are also familiar with the requirements of the service. The general rule is also that they are better photographers, since that is their professional occupation.

Free lancers, however, are very important in the life of a photo service. It very often

happens that a free lancer gets the first and often the only picture of a news event. Most of the dramatic pictures of accidents at sea are the work of amateur photographers, and one truly great news picture came from an amateur photographer who had the presence of mind to take a picture as he stood on the slanting deck of the sinking *Tesiris*. It holds its punch to this day.

But by and large, the bulk of the great news pictures—and these are incapable of being posed—are taken by professionals. It seems to be a matter of "know how." When the zeppelin *Hindenburg* exploded at Lakehurst, not a single press photographer lost his stride, and for once there were enough shots to satisfy any editor. But of all the amateur photographers on hand, only two or three got pictures good enough to be published.

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NEWS PHOTO ROUTINE

The customary route of a news photo taken, say, in New York by a staff photographer would be this:

A wet print or sometimes a developed negative, is examined by an editor. He

determines its news interest, decides what subscribers should receive it, and the size print that should be delivered. If retouching is required, a glossy print goes to the artist. Meantime the caption has been written and the picture either scheduled, as in the case of the A.P., or offered to sub-



BELGIAN FAMILY—WORLD WAR II. Here the camera has recorded the major tragedy of this war—the bombing of civilians. This Belgian family has just been made homeless by German bombs. The photo is well taken and represents camera journalism at its best

Photo, Acme



CLOSE CALL. In this fast action flash, a Boston Bruins shot for the goal has been stopped by the New York American's goalie. An important part of camera journalism is coverage of sports—and sports pictures are getting better and better, thanks to synchroflash photography
International News Photo

scribers by telegraph in the case of the other services. If the picture is to be serviced by mail, the captions will be mimeographed for attachment to the photograph.

By and large, the pattern of photo coverage has followed that of spot news. It is erratic, seldom predictable, and requires a constant readiness on the part of an agency to cover anything, anywhere, not knowing whether it will be a ship in distress, a school bus caught in a blizzard, a plane lost in the Western mountains, or a 4-H Club winner. This is expensive, but it is necessary. To some degree it accounts for a certain sameness about many news photos—auto accidents tend to look alike, for example. It also permits little planning of the news photo report, and in the frantic hurly-burly resulting, social discernment is rarely possible.

Social trends—the mechanization of agriculture, the migrants, etc—which might lend themselves better to pictures than to textual reporting, are handled on a spot news basis. Since this is as true of the text news services, perhaps the whole field is best left to the periodical press where more thoughtful editing is possible.

In the spot news field, the demand for speed makes for a more mechanical type of picture. This is a handicap which the large agencies cannot escape. But all would like to and make a deliberate effort to do so, particularly in compiling their picture reports for rotogravure sections. Here, however, tradition imposes handicaps. Most American gravure sections have limited themselves to purely pictorial subjects, and only a few have so far realized the great possibili-



WAR VICTIM. In the ruins of the South Station at Shanghai, this helpless baby sits crying. This is perhaps the best known photo to come out of the Sino-Japanese War, symbolic of the innocent Chinese civilian bombing victims

International News Photo (News of the Day)

ties of this medium for picture series which do tell a story. This influence is growing and undoubtedly will continue to do so.

So-called "candid" photography, which had a great vogue when German miniature cameras made their first appearance, has now been relegated to its appropriate occasional use.

PICTURE MAGAZINES

An entirely different approach is possible in the periodical field. Here speed, while important, is not the first essential. Editors have greater opportunity to estimate pictorial values, and photographers can be more careful with what they get and still make a deadline. The fine results, and the sensational public welcome which picture magazines have received, will undoubtedly tremendously influence all American pictorial journalism for the better.

The editors of a picture magazine are able to draw from a wider field than the news editor, since they publish but once a week, or bi-monthly. The editors of *Life*, for example, examine some 15,000 pictures weekly, whereas the picture editor on a metropolitan newspaper is unlikely to see many more than 1,000.

The photographs required by pictorial magazines and newspapers, while falling in the same broad informational category, have vital differences. The field of the magazine is more inclusive, in the first place, and often pictures are intended to be explanatory in a patient way. A newspaper literally has no time for this.

NEWS PHOTO REQUIREMENTS

The great market for pictures is, of course, the daily newspaper, of which there are 2,000 in the United

States. Their requirements cover almost every conceivable field, but their great necessity is spot news pictures.

A spot news picture must answer the same questions that a news story must answer. It is only a fragment of any action, and it must therefore tell its story clearly, and as completely as possible, because there is no second paragraph, no "turn to page 16" to help out a news picture's failings. Either it tells its story or it doesn't. But if it lacks some of the accordion-pleated virtues of text, it has its own. The picture of the stunned and wounded Chinese baby crying on the railway platform of the bombed North Station in Shanghai told more about the first exhibition of modern aerial warfare than the thousands of words that came by cable.

All of the careful technic a photographer can learn is needed in a news picture. Com-

CAMERA JOURNALISM

position, definition, the angle—they are as important in a news picture as punctuation and grammar in a news story. The pressure of accident and speed often make them neglected when they should not be.

A news picture must have news interest—and this is relative. An auto accident may be interesting in its own locality and dull elsewhere. But a crack train plunging into a western river is news anywhere.

It must have action and human appeal when it can, and be composed with a thought to the limited reproduction facilities of newspapers, which print at high speed on cheap paper. And it must be understandable. Just as a reporter ever strives to tell his facts in a new and interesting way, so must the photographer seek constantly a fresh approach. Above all, a news picture must be completely honest. There is no place for any other kind of news photography and a false photograph and its maker fall into the same category as the reporter who colors and falsifies his story.

SOURCES OF NEWS PICTURES

The average number of pictures distributed by the major syndicates will vary from around 500 to something more than 1,000 a week, depending to a degree upon the type of service being supplied. They are not by any means the only picture sources available to editors. Pictures can also be obtained from:

News cameramen

Local commercial and portrait studios

Local amateur photographers

Picture agencies:

Feature pictures

Historical pictures

Foreign pictures

Professional free lance photographers:

Taking pictures on order

Specializing in certain classes of pictures

Professional color photographers

National advertising agencies:

Travel pictures

Industrial pictures

Fashion pictures, and many other special subjects

Publicity pictures from:

Hollywood studios and their Eastern representatives

Radio broadcasting companies

Airlines and Industry

Chambers of commerce:

Scenic views of their municipality

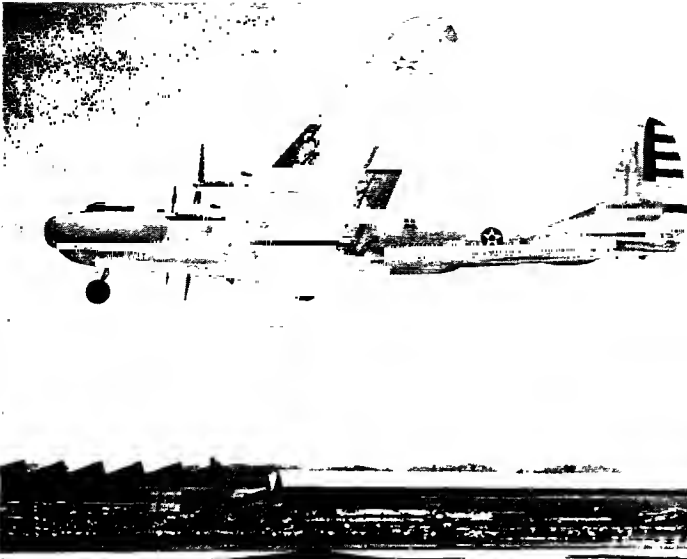


LUCKIEST KID IN NEW YORK. Typical of camera journalism's feature photography, this one is part of the hot weather theme. The caption was: "Just imagine the mixed emotions experienced by this very young man who seemed quite surprised when a sprinkling truck came right up to him during the 90° heat in Gotham and doused him with water. The youngster seemed quite prepared from the sartorial viewpoint but we prefer to believe it all came as a beautiful surprise."

INP Photo, Jesse Strait

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SYNDICATES AND AGENCIES



B-19. While the employees of the Douglas Aircraft Company line the factory's field in California, this immense airplane takes off. It is the maiden flight for this 82-ton bomber. Notice that the plane, filling almost the entire picture space, looks what it really is—big. Notice, too, the bomber's shadow on the ground

Photo, Acme

United States Government departments:

Army and Navy departments have huge files

Other departments can furnish pictures on scientific subjects, bird and animal life, housing, farm conditions, soil conservation, engineering projects, etc.

Public libraries:

Pictures in books can be photographed

Picture collections

News and picture magazines:

May resell special feature pictures which they've published

Art galleries and museums:

Furnish free or sell photos of paintings on exhibition

Foreign chambers of commerce in New York:

Give or sell many feature pictures showing activities of all natives in various lands

Corporations, Industries, Railroads, etc.

Some of the better-known New York Syndicates and picture agencies are listed below:

Acme News Pictures, Inc.:

Spot news, roto features, magazine section features

Associated Press: Spot news, feature pictures

Black Star Publishing Company: Photographs of general subject interest—scenic, industrial, human interest, sports, all magazine and advertising material

Cooperative Features, Inc.:

Candid camera shots, action photos of prominent people

European Picture Service: News and feature photos for sale in this country and abroad. Also action pictures with human interest, candid, or color work

Ewing Galloway: Stock photos for resale to illustrate magazines



STRIKE. A famous photograph of a well-known strike in South Chicago showing police beating strikers, this was taken in 1937 and is still one of the most unusual of action shots. It was used for spot news at the time and has been used repeatedly ever since for other journalistic purposes

Photo, Press Association



STOPPING TRAFFIC. When Frosty, the cat of the Chicago South Park Service Yard, insisted on taking her kitten across Michigan Boulevard during the rush hour, Officer Anthony Schmitt stopped all traffic. Taken in 1929, this is an old and famous feature picture—but its appeal value has not diminished with the years
International News Photo

Famous Feature Syndicate: Illustrations for articles and short stories for syndication to Sunday magazine sections of newspapers

Free-Lance Photographers Guild, Inc.: Feature photos for all purposes

International News Photo Service: Spot news and feature photos

N. E. A. Service, Inc.: Spot news, sports, features

R. I. Nesmith & Associates: Feature photos for all purposes

Pan-American Pictures: Pictures suitable for publication in Latin America

Pan-Hellenic American Foreign Press Syndicate: Photos and news from Balkan states, especially Greece

Pictorial Features Service: Photos for advertising purposes, industrials, fashions, displays

Pix Publishing Co.: Photos of general subject interest including some which have appeared in *Life Magazine*

Press Association (Subsidiary of Associated Press): Photos for magazine and commercial use

Underwood and Underwood: Advertising, news, commercial

Science Service: News pictures of science, nature, technology

Universal Trade Press Syndicate: Business and class journals photos

Wide World Photos: Spot news for newspapers and magazines

The news reels offer a subsidiary source of news pictures which is often important. News reel photographers cover much the same variety of output that news photog-



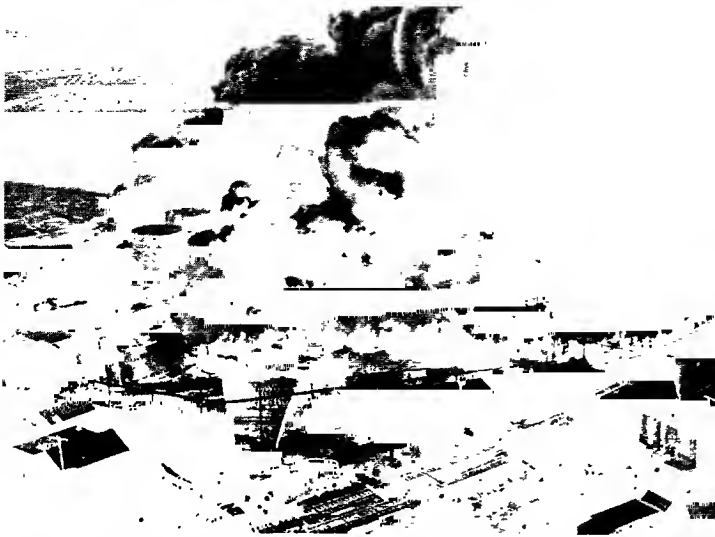
ST. VALENTINE'S DAY MURDER. These Chicago racketeers were executed by a rival gang in one of the most famous—and unpleasant—of gangster news stories. A necessary part of camera journalism is such coverage
International News Photo

raphers do, and because of the nature of their equipment they occasionally get a picture which has escaped the still man. To the editor this is not of consequence. He is interested only in the picture, not how it was obtained. The only pictures of the Japanese bombing of the U. S. gunboat *Panay* were obtained by newsreel photographers.

The results that can be obtained from enlarging a negative as small as a movie frame are sometimes remarkable. Some have



TRAGIC AFTERMATH. In this truck-taxi crash, a woman pedestrian was killed. The man, covering his face, is her husband. An eloquent news picture of human tragedy
INP Photo, Jesse Strait



OIL EXPLOSION. On October 12, 1938, the refining plant of a Linden, N. J. oil company provided one of the most spectacular blazes ever seen in the East. This photo shows an airplane view of 7,000,000 gallons of oil going up in smoke. See accompanying photograph for an "aftermath" shot
INP Photo, Michael Baron

Education and the Public Health Service are converts too.

There are a number of independent photographers operating in this field, as well. Some are searching out their own subjects, others working on assignments from foundations and other organizations. An examination of books of photographs published in the last half dozen years will show how important a field this has become (See *Documentary Photography*).

The American and European press make rather different use of pictures. Until recently the European tendency had been toward feature and off-the-news pic-

tures. The U. S. press found straight news pictures only of interest. With improvement of American newsphoto technic, however, the European, and particularly the English press has tended to follow the American lead.

That is, until the World War II broke out. Even before the war, German photogra-

phers found straight news pictures only of interest. With improvement of American newsphoto technic, however, the European, and particularly the English press has tended to follow the American lead.

EDUCATIONAL AND DOCUMENTARY PICTURES

The enormous expansion of the use of pictures to tell news stories has had its repercussions in other fields, particularly in the field of education and social documentation. In the final analysis these are news pictures.

The government, for example, in endeavoring to make understandable the necessity for soil conservation, found photographs a dramatic medium. The Department of Agriculture probably makes the widest use of the photograph, but other divisions of government, such as the Office of



OIL EXPLOSION—AFTERMATH. The smoldering ruins and debris of a huge New Jersey oil explosion are shown here—an aftermath shot of the blaze shown in the accompanying photograph. It was estimated that the damage was \$4,000,000. Notice the bulging, expanded tanks
INP Photo, Michael Baron

CAMERA JOURNALISM

phers were government directed, and by skillful propaganda direction, the Nazis made use of photographs as an active military arm. They helped build the legend of Nazi invincibility. No picture now comes from Germany which is not a propaganda picture. Other nations are alert to the need of pictorial presentation of their case, and the Germans are no longer alone in this field.



MAYOR GAYNOR SHOOTING. On August 1, 1910, Mayor William Gaynor of New York was sailing for Europe and posed for cameramen. One of them, Wamecke of *The World*, was late and just as he was ready to snap his picture, a discharged city employee shot the mayor. The cameraman got the photo as the mayor staggered and fell. He was not killed. This is one of the well-known photographs of American camera journalism
International News Photo

FUTURE OF PHOTO-JOURNALISM

The next ten years seem to promise for photo-journalism a broad expansion. The technic of distribution by wire is largely solved. The use of radio for transmission—either short wave or Frequency Modulation—seems indicated, with a probable saving in cost. Likewise, photo transmission machines delivering a finished engraving, instead of a print, are expected to be in operation by the end of 1941. These will extend the benefits of wired pictures to small newspapers which cannot now afford to maintain



CERMAK ASSASSINATION. In an attempted assassination of President Roosevelt in Miami, Florida, Mayor Cermak of Chicago was shot. Here he is shown being assisted to an automobile. Many photographers were on the scene and this *International News Photo*, with its blurred flash, gives an excellent impression of the hectic excitement
Photo, Sam Schulman

engraving plants. This means that pictures will be transmitted to hundreds of papers instead of scores.

With the problem of distribution pretty well solved, the emphasis in photo-journalism from here on promises to be on editorial or news content, coupled with a demand for better pictures technically.

While the chief responsibility lies with the photographer, picture editors will be sharpening their technic too. The last five years have been years of great experimentation on newspapers, and some of the rewards are beginning to appear now. Few newspapers are satisfied that they are doing everything possible with pictures—and that is the best promise of progress.

Photographs will improve as photographers study their craft and have better equipment available. The introduction of fast film and flashbulbs alone permit pictures to be made under conditions unthinkable a few years before. But tomorrow's photographer must be more than merely technically competent. As the world in which we live changes, news interests change, too. Thus, all people are far more interested in the social developments which affect their lives, and tomorrow's photographer must be able to

make seemingly abstract news stories pictorially understandable. He must know why he is taking his picture.

The great and impregnable virtue of photo-journalism lies in the saying attributed to a Chinese philosopher, who said that a picture was worth 1,000 words. That is only true when a picture has something to say. And apart from accident, a picture only repeats what the photographer was able to see. If he is blind, the picture will reflect his blindness. Truly, tomorrow's photographer, if he is to hold a mirror to his world, must be a photo-journalist.

CAMERA OBSCURA. Before the invention of the modern photographic camera, portable "camera obscuras" were made, by which images of external objects were projected through a hole or lens upon a white sheet of paper or translucent screen. Some of these camera obscuras were small light-tight boxes; others were tents or rooms large enough for the observer to see the image while standing inside. These big camera obscuras were merely darkened, light was allowed to come through a small hole and cast the outside image upon a white sheet within. Before Daguerre appeared to make the image thus projected permanent, camera obscuras were used by artists for the purpose of tracing images preparatory to a final etching or painting.

The principle upon which this earliest camera worked goes back to Grecian times when Aristotle made reference to the fact that if all the light is shut out of a room except that entering through a small aperture, an image of objects outside will form about a foot from the opening. A manuscript of Leonardo da Vinci, dated before 1519, contains a diagram of the device but does not refer to it as one of his inventions. In the sixteenth and seventeenth centuries the principle of the camera obscura was mentioned by Italian and German writers.

The Latin word for an enclosure or room is "camera," so a darkened room becomes a "camera obscura."

In 1553, Jean Baptiste Porta published a book of pseudo-science and magic which did more to popularize the principle of the camera obscura than had all the scientific works

which had preceded him. The use of lenses was discovered sometime between the thirteenth and the sixteenth century—or rather, it was rediscovered since lenses had been used for certain purposes by the Chaldeans, the Chinese, and the Romans in the days of Nero. And Roger Bacon, thirteenth century English friar and scientist, showed some knowledge of lenses in his *Opus Majus*.

In 1568 a Venetian nobleman, Daniello Barbaro, mentions a camera obscura equipped with a lens. The use of a lens in place of a small aperture improved the definition and the brilliance of the image. Sixteen years later the device was mentioned again and in 1611 Johannes Kepler in his *Dioptrice* dealt at length with the principles of the camera obscura and the advantages of a compound lens over a simple plane convex lens. After this the camera obscura became well known. There were many different models, used for a variety of purposes. Artists found the camera obscura of great use as an aid to sketching. The camera lucida, another aid to sketching based on a different optical principle (see article on *Camera Lucida*) is sometimes confused with the camera obscura.

The development of the camera obscura into the camera was a long and laborious one, consisting of many experiments designed to furnish a permanent record of the image. In 1826 Nicéphore Niepce, a Frenchman, succeeded in recording a permanent photograph with the camera obscura equipped with a lens—but the exposure took from 6 to 10 hours in bright sunlight. The picture was flat and lacking in contrast and detail so this process was not practical. Experimentation continued and it was left to Louis Jacques Daguerre to make the transition from the principle of the camera obscura to the camera in 1839.

Actually the modern camera is a direct application of the principle of the camera obscura. Every camera is nothing more than a dark chamber or box into which the image of external objects is projected by means of a lens or some other image-forming device. The pinhole camera (see article on *Pinhole Photography*) is the nearest thing to the pure camera obscura available and it is a far cry from the camera of today.

CAMERAS FOR ALL PURPOSES

Willard D. Morgan

General Editor, THE COMPLETE PHOTOGRAPHER

In this survey, more than 60 modern cameras are discussed, pictured, and classified. Every photographer wants to buy another camera—no matter how many he already has—and this is the comparative guide which will help in the choice. In addition to the comprehensive survey, advice is given on how to choose, buy, and use the various cameras, the relative merits of different focusing devices, shutter systems, and viewfinders. The whole field is covered—from the \$1.00 box camera to the \$350 miniature. A similar article is scheduled for the motion picture camera.

Prices are given for comparative purposes only and are, of course, subject to change

See Also Box Cameras, Cine Cameras, Contax, Ektra, Focal Plane Shutters, Graphic and Graflex, How Your Camera Works (p. 37), Leica, Lenses, Miniature Photography, Range Finders, Reflex Cameras, Shutters, Swing Adjustments, Twin-Lens Cameras, View Cameras

AS ALL photography is so dependent upon the basic camera, it is essential that we become familiar with this ingenious mechanism. Up until the twentieth century cameras were quite simple—consisting of the familiar view camera with groundglass for focusing, and the box type of camera. After all, a picture *can* be made simply by using the light-tight typical box camera. A lens in one end and the sensitive film in focus at the other end of the box complete the essentials. However, photographers demanded much more than this. They asked for faster lenses, better focusing methods, lighter, smaller, and more compact cameras, faster film emulsions, and many other improvements.

New camera developments came rapidly during the last fifteen years. In fact, by 1930 the 35mm miniature camera was just taking root in this country. A few years later the auto-focusing cameras began to appear with range finders built into the camera and coupled to the lens. About this time the twin-lens cameras, such as the Rolleiflex and Ikoflex, began to make their mark in the world. Improved folding cameras of the Kodak type and single-lens reflex cameras came along by the dozens.

During this past decade of unprecedented camera development even the older cameras such as the Speed Graphic, Maximar, Rec-

omar, and others were injected with new life by the addition of flash synchronizers and lens-coupled range finders. Photographic manufacturers were working overtime to fill the new demands and meet new competition, thus creating one of the most important periods in photographic history. Today photographers are continuing their many demands for improvements in camera equipment.

Naturally with hundreds of cameras to choose from the average photographer becomes bewildered. First of all each individual must stop a moment and ask himself just what types of pictures he is interested in. Are you interested in taking only the average outdoor snapshot? Pictures in the shade or weak light? Interiors or pictures of fast action? Are you interested in obtaining news pictures or commercial views, or possibly you may be like many other photographers who are looking for the ideal camera to do everything?

There is no single camera for every purpose. The same is true with an automobile. No one method can cover every requirement. Some are slow while others are speedy. Some are made for a lower price range while others have all the finest expensive trimmings.

HOW TO BUY A CAMERA

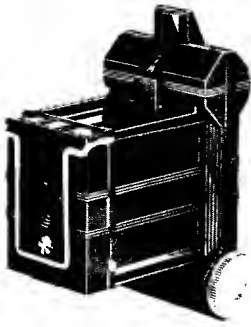
A good camera almost has a personality in itself. This is undoubtedly why we all take such a keen interest in choosing the type of camera we plan to work with. Each photographer naturally must decide for himself. Here is where it will be of value to review some of the essential points of cameras.

1. Determine the film size. Miniature films must all be enlarged while larger films can be contact printed. Consider the variety of emulsions available for each film size.

2. What type of camera can you afford? Good cameras at reasonable prices under \$15.00 can be purchased. On the other hand, still better cameras at higher prices are available in all types. You can go as high as \$350.00.

3. Choice of lens. A few years ago, before the present popular development of synchronized flash photography, the high speed lens was in great demand. Today it is not so essential to have an f/1.5 or f/2 on your

THE COMPLETE PHOTOGRAPHER

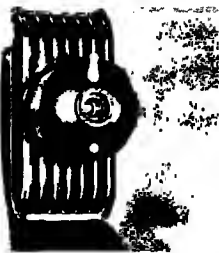


UNIVEX A

Facts: Box camera; Univex No. 00 roll film; 6 pictures of $1\frac{1}{2} \times 1\frac{1}{2}$; f/16 lens; rotary shutter; second; wire frame finder; fixed focus

Special Features: Built of textolite
Comment: This little camera is the height of simplicity and practically unbreakable

Price: \$.55



BULLET

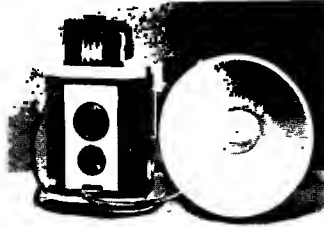
Facts: Box Camera; $1\frac{1}{2} \times 2\frac{1}{2}$ pictures; meniscus lens; one aperture;

Bulb and Instantaneous; folding eye-level wire finder; fixed focus
Special Features: Spiral front lens; molded camera body; carrying case available

Comment: For the beginner it is a practically fool-proof and destruction-proof camera. Good for children

Price: \$2.35

Distributor: Eastman Kodak



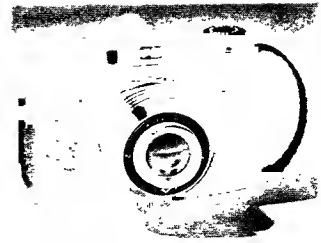
BROWNIE REFLEX

Facts: Twin-lens box camera; 127 or A8 roll film; 12 pictures of $1\frac{1}{2} \times 1\frac{1}{2}$; meniscus lens; Bulb and Instantaneous; groundglass reflex finder; fixed focus

Special Features: Built-in synchroflash with available flash unit

Comment: For a box camera, this has two special features—the synchroflash and the reflex finder. Both are useful and will help make photography more interesting for the worker who has gone past the rank beginner stage. Still another feature is the extra brilliant

full negative size view finder
Price: With flash unit, \$6.35



AGFA CHIEF

Facts: Two-focus box; PB20 roll film; 8 pictures of $2\frac{1}{4} \times 3\frac{1}{4}$; meniscus lens; rotary leaf shutter; Bulb and Instantaneous; optical eye-level finder; two-zone helical focusing

Special Features: Two-zone focusing with automatic haze filter for distant focus; all-metal cone for loading; hand strap; built-in synchroflash socket

Comment: The two outstanding features are the socket for flash and the built-in haze filter. The former is very useful for making indoor shots; the haze filter can do a good deal to cut haze in landscape shots. Worth the money. Chief comes also in PD16 size. A companion to the Chief camera is the Agfa Pioneer. This camera is similar in appearance and also has the built-in flash unit facilities. The price is slightly lower than the Agfa Chief

Price: \$4.75 (flash unit is \$1.00 more)

camera if you are using flash. You can take 95% of your pictures with a good f/4.5 anastigmat lens on a good camera. Wherever possible buy a good anastigmatic lens.

4. A good shutter is another essential. Such a shutter should have a wide range of speeds, from Time to $\frac{1}{2000}$ of a second or more.

5. If the camera you select has a lens-coupled range finder, it will be much easier to secure accurate focus. The reflex cameras show the image in exact focus on a groundglass. Such cameras are also recommended for accurate focusing. Many of the regular roll film folding cameras can have supplementary range finders attached, or, with a little experience, you can estimate distances with a fair degree of accuracy. With the average lens diaphragm stopped down to possibly f/16 or smaller, there is a good depth of field which will overcome any slight error in guessing distances.

6. Check the view finders to see if they are in good working order and in accurate alignment.

7. Check cameras for any light leaks in the bellows, loose camera backs, or any other parts which might throw the picture out of alignment or cause vibration. Examine the focusing track and any locks in the cameras which may have worked loose.

These are some of the essential points to observe when inspecting cameras before purchasing. Also obtain the descriptive catalogs on the cameras you are interested in. A careful reading of this literature will give you additional comparative material. Then when you have convinced yourself that a certain camera model is the ideal outfit, go right ahead and buy it.

A further aid in classifying and deciding upon the camera you wish to purchase comes with an understanding of the various camera

CAMERAS FOR ALL PURPOSES

groups. The following ten groups of cameras should be studied very carefully. The points and advantages of each group are briefly stated and at the same time actual names of cameras given. The accompanying illustrations give a better idea about some of the important cameras of the various groups.

1. Box and Fixed Focus Cameras
2. The Folding Roll Film Cameras
3. Auto-focusing Cameras
4. 35mm Miniature Cameras
5. The Larger Miniature Cameras
6. Twin-Lens Reflex Cameras
7. The Single-Lens Reflex Cameras
8. The Sheet-Film Pack Cameras
9. View and Studio Cameras
10. Special Cameras

1 BOX AND FIXED FOCUS CAMERAS

These cameras are familiar to everyone. They include such box cameras as the Agfa Shur-Shot and Cadet, the Kodak Brownie Six-16 Jr., Brownie Specials Six-16 and Six-20, Brownie Six-20, the Target Brownies Six-16 and Six-20, Baby Brownie, Baby Brownie Special, the Bullet Camera, Bull's Eye, and Six-20.

Recent developments have added built-in flash synchronizers to these cameras, greatly extending the photographic range and picture possibilities. This makes it possible for the familiar fixed focus box cameras to be used indoors or outside at any hour of the day. Wherever the light is weak or entirely missing, it is easy to slip on the compact synchronized flash unit and snap the picture. The Six-20 Flash Brownie is a good example. If this camera is loaded with Verichrome or Panatomic-X Film, use a No. 5 Midget Flash Bulb at 6 feet from the subject. If Super-XX Pan Film is in the camera, it is necessary to step back and allow 13 feet between camera and subject. These exposures just give a rough idea about the picture taking possibilities with the Flash Brownie indoors.

Usually the box camera lens has a relative aperture of $f/12.5$ to $f/16$. For a complete story and survey see *Box Cameras*.

2 THE FOLDING ROLL FILM CAMERAS

Cameras in this class usually have a leather or composition bellows with lens

mounting which folds compactly into the camera body when not in use. Such cameras include the Agfa Readysset Special Speedex and Viking, the Kodak Monitors and Vigilants.

Sometimes the folding roll film type of camera is referred to as a blind camera. In other words, there is no groundglass on which to view the full negative size image. In most cases these lenses do not have a coupled range finder.

The lens apertures of the folding cameras are usually around $f/4.5$ and $f/6.3$ with some models having faster lenses.

3. AUTO-FOCUSING CAMERAS

This class of camera is really an outgrowth of the regular folding roll film type. These cameras have built-in lens-coupled range finders for focusing. Examples include the Zeiss Super Ikonta A Special, Super Ikonta B, and Super Ikonta C Special. Also the Super Kodak Six-20. These auto-focusing roll film cameras have carried over the original advantages included on the Leica and Contax cameras.

During the last few years one of the most important developments in the larger camera size has been carried out with the auto-focusing cameras. These cameras have the advantage of larger negative sizes combined with the roll film features. Today the larger roll film emulsions are available in many different speeds and emulsions. The more serious photographer will find some excellent values in these cameras.

4. 35mm MINIATURE CAMERAS

The early miniature cameras, such as the Leica and Contax, created a tremendous interest in the use of standard 35mm motion picture film. This film came in a variety of emulsions and was easily obtained anywhere. The low cost per picture was also a contributing factor in the popularity of these small cameras. Other 35mm's include the Kodak 35, Ektra, Argus, Perfex, Agfa Memo, and Kine Exakta.

The popularity of the 35mm camera is still on the increase. With the steady improvement in films, developers, and cameras, photographers are getting better results each year. One of the important things to re-

member when using the 35mm camera is to obtain wire-sharp focus so that negatives can be enlarged without any undue loss of definition. Another important thing to observe is that the central subject of interest should fill the entire frame of the 35mm negative whenever possible.

With a wider use of still projectors, the 2 x 2-inch black and white and colored lantern slides are requiring the steady use of 35mm cameras. Kodachrome 35mm color pictures are quite economical to make. It is within the means of the average photographer to form an interesting collection of color slides.

Other features of the 35mm miniature camera include light weight, short focal length lenses which give extra depth of field in the picture, lens-coupled range finders, economical film cost, wide choice of interchangeable lenses.

The better class of miniature cameras such as the Contax, Ektra, and Leica are discussed in separate articles (see *Contax*, *Ektra*, and *Leica*). They are capable of making such pictures as: 1. fast action shots up to $\frac{1}{1000}$ of a second; 2. wide-angle and distant shots by using interchangeable lenses; 3. astronomical pictures through a telescope; 4. photomicrographs with attachments; 5. Kodachrome color pictures; 6. close-up copy work with special attachments; 7. portraits; 8. typical candid pictures indoors or outdoors; 9. fast sequence pictures, and many others. (See also article on *Miniature Photography*.)

5. THE LARGER MINIATURE CAMERAS

The miniature camera field has been loosely divided into two groups. Group 1 includes the cameras using 35mm film, while Group 2 includes the miniature type of camera with film sizes ranging between 35mm and the $2\frac{1}{4} \times 3\frac{1}{4}$ -inch sizes. Cameras in this group include the Agfa Clipper Special, Ikonta A Special, Ikonta B, Kodak Bantam Models, Exakta B, and the Miniature Speed Graphic.

The larger cameras are heavier in weight which is sometimes an advantage, sometimes not. Larger contact prints can be made. The larger negative size does not require such extremely fine grain processing as the 35mm films. It is also possible to use the larger camera very successfully with flash synchronizers.

6. TWIN-LENS REFLEXES

The twin-lens cameras such as the Rollei-flex and Ikoflex, have two matched lenses of the same focal length—one for actually recording the picture and the second lens for visual focusing upon a groundglass.

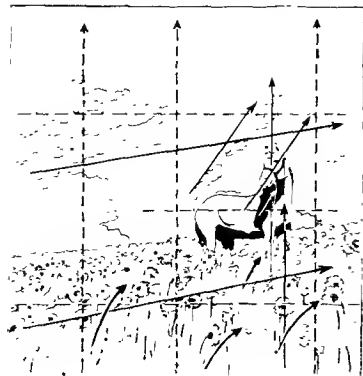
When focusing the twin-lens reflex, it is important to consult the depth of field scale in order to find out just how deep the depth of sharpness extends. The focusing lens does not have a diaphragm. This means that all focusing is done with this lens wide open. However, the picture-taking lens has an adjustable diaphragm.

(Continued on page 579.)

COMPOSITION ANALYSIS for . . . HORSE ON HILL

At first sight the picture seems to derive its effect from a powerfully rising motif: the field slopes upward; the high figure of the horse stands atop, with raised head; finally, there curves the sky above. The entire character of the picture appears to be crystallized in the "upward" cry.

On closer study it will be found, however, that there are really two conflicting trends, the sum total of which achieves a perfect unity. The one is vertical, the other horizontal.



Starting with the vertical from the bottom up, we have the vertically pointing stems of the flowers. The trend is taken up by the horse's straight forelegs on the right hand side, and by the towering effect of the clouds on the left hand side, also by the ladder-like arrangements of the little puffs rising from the horse's croup. The upward motif is continued by the rope leading up to the bit, by the fine line from chest to throat latch, by the deep shadow thrown across the shoulder, by the slanting line of the face, and last but not least by the straight-pointing ears.

But how successful would be the vertical composition were it not for the balancing effect of the horizontal motif? Be it noted that the flowers point to the right, that the field appears to rise toward the right, that the clouds evidently are drifting in the same direction. Finally, the body of the horse parallels this trend toward the right—a trend which is accentuated by the fact that the horse turns its face in the opposite direction.

One will do well to give serious attention to the principle that in the perfect picture one emphatic trend, such as the vertical one, must be balanced by its horizontal counterpart.

Gerard Hirschfeld



HORSE ON HILL

FLORENCE HIGGINS

This photograph won a \$500.00 First Prize award in a contest run by the Newspaper National Snapshot Award Salon. See Contest Photography



THANKSGIVING DINNER

JACK DELANO

An original and interesting documentary photograph in this one showing the Thanksgiving dinner of a Rogerine Quaker—Timothy Levy Crouch—in Ledyard, Connecticut. Farm Security Administration photographers are busy recording, for the government, such socially important points as: how America lives, what it does, how it works and plays, how it eats and clothes itself. See *Documentary Photography, Reflections*
Photo, Farm Security Administration



GOING DOWN!

HARRY MAMAS

This remarkable photograph was made from the conning tower of a submarine just as the seething waters closed over the hull. It shows an American sub going down off New London, Connecticut, and is typical of the photographically interesting, up-to-the-minute, and yet interpretative pictures which photo agencies are now providing their subscribers

Photo, Acme Newspictures (Roto Service)



WATER BALLET

FRANK SCHERSCHEL
Chief Photographer, Milwaukee Journal

An interesting new phase of photography in camera journalism is the speedlamp or stroboscopic flash—making possible exposures at $1/10,000$ second or less. Some subjects are not suited to such exaggerated stop action, but here the water patterns make a good picture. See Speedlamp and Sports Photography. DATA: $f/11$, 3 stroboflash lights

CAMERAS FOR ALL PURPOSES

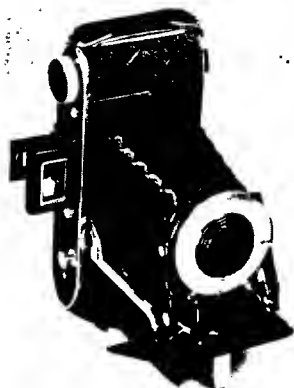


AGFA VIKING

Facts: Folding roll film camera; PB20 roll film; 8 pictures of $2\frac{1}{4} \times 3\frac{1}{2}$; anastigmatic lens; $f/32$ to $f/7.7$; leaf shutter; Time, $\frac{1}{2}$ to $\frac{1}{1000}$ second; collapsible eye-level and waist-level finders; manual focusing; 5 feet to Infinity

Special Features: Self-erecting front; built-in body shutter release

Comment: The Viking comes in 4 models: PB20 size of $f/6.3$ and $f/7.7$, PD16 size of $f/6.3$ and $f/7.7$. This is a good, streamlined version of the folding camera
Price: \$15.50 ($f/6.3$ PD16 size is \$20.75)



AGFA READYSET SPECIAL

Facts: Folding fixed focus; PB20 roll film; 8 pictures of $2\frac{1}{4} \times 3\frac{1}{2}$; achromatic lens; $f/32$ to $f/14$; leaf shutter; Time and Instantaneous; optical eye-level finder; fixed focus

Special Features: Built-in shutter release

Comment: The Readyset comes in two models: the PB20 and the PD16. With a four-aperture diaphragm and eye-level finder this is easy to handle. A good one for beginners

Price: \$11.75 (The PD16 is \$13.25)



IKONTA B

Facts: Folding roll film camera; 120 or B2 roll film; 12 pictures of $2\frac{1}{4} \times 2\frac{1}{4}$; 3-inch Tessar lens; $f/3.5$ to $f/22$; Compur-rapid shutter; Bulb, 1 to $\frac{1}{1000}$ second; eye-level sports finder; manual focusing, 4 feet to Infinity

Special Features: Two-dot system for fast standard focus; plunger type body shutter release with automatic locking; screw-on lens accessories

Comment: This is a handy and versatile folding camera, comparable to any others in the field
Price: With Tessar $f/3.5$, \$72.00; with Novar $f/4.5$, \$45.00

Distributor: Carl Zeiss, New York



IKONTA C SPECIAL

Facts: Folding roll film camera; 120 or B2 roll film; 8 pictures of $2\frac{1}{4} \times 3\frac{1}{2}$; 10.5cm Tessar lens; $f/4.5$ to $f/32$; Compur self-timing shutter; Bulb, 1 to $\frac{1}{1000}$ second; eye-level sports finder; manual focusing; 4 feet to Infinity

Special Features: Two-dot system for fast standard focus; self-timing; shutter release on camera body; locking device to prevent double exposure

Comment: Very similar to the Ikonta B, this is the old familiar folding camera—streamlined
Price: With Tessar $f/4.5$, \$66.00



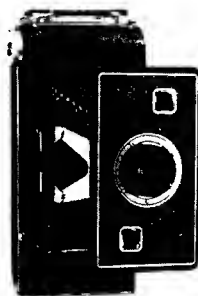
JIFFY KODAK V. P.

Facts: Folding roll film camera; $1\frac{1}{8} \times 2\frac{1}{4}$ pictures; doublet lens; one aperture; trigger shutter; Bulb and Instantaneous; eye-level finder; fixed focus

Special Features: Recessed lens for protection; direct pull-out bellows

Comment: As a vest pocket camera, this is new and good

Price: \$4.90

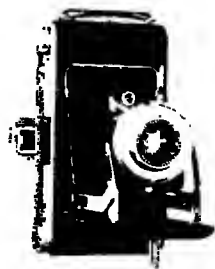


JIFFY KODAK

Facts: Folding roll film camera; 616 film; $2\frac{1}{4} \times 4\frac{1}{4}$ pictures; Tindar lens; one aperture; Instantaneous and Time; waist-level finder; near-and-far two-position focusing; 5 feet to infinity

Special Features: Direct and easy pull-out bellows

Comment: Very easy to carry, this camera has the simplicity of a box camera. Comes in Six-20 model
Price: \$9.00 (Six-20 is \$8.25)



KODAK MONITOR SIX-20

Facts: Folding roll film camera; 620 roll film; $2\frac{1}{4} \times 3\frac{1}{2}$ pictures; 127mm anastigmatic lens; $f/4.5$ to $f/32$; No. 2 Supermatic shutter;

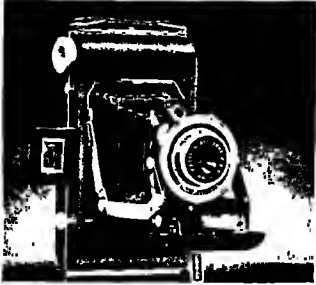
THE COMPLETE PHOTOGRAPHER

Bulb, 1 to $\frac{1}{100}$ second; eye-level and waist-level finder; manual focusing with revolving lens mount; 3½ feet to Infinity

Special Features: Depth of field scale; exposure counter; accessory clip; body shutter release

Comment: This comes in Six-16 size also—both sizes have f/4.5 and f/6.3 lenses. This looks like a regular folding camera, but operates like a miniature

Price: \$45.50 (Six-16 is \$51.50; Kodamatic shutter is less than Supermatic



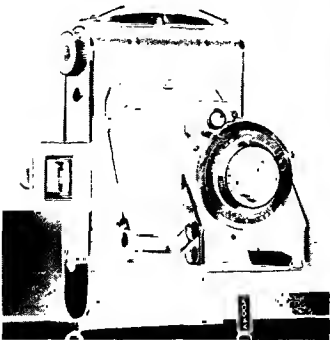
KODAK VIGILANT SIX-16

Facts: Folding roll film camera; 616 roll film; 2½ x 4½ pictures; special anastigmatic lens; f/8.8 to f/32; Kodex shutter; Time, $\frac{1}{2}$ to $\frac{1}{100}$; eye- and waist-level finders; manual focusing with revolving lens mount; 4 feet to Infinity

Special Features: This camera has the features common to many of the new roll film cameras—rigid construction, eye-level finder, body shutter release

Comment: A good practical camera with a better-than-average lens
Price: \$17.00 (f/4.5, Supermatic, \$45.50

See also other Vigilants Six-20 and Junior.



KODAK VIGILANT SIX-20

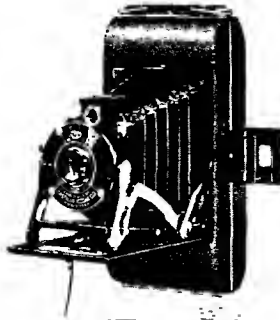
Facts: Folding roll film camera; 620 roll film; 2½ x 3½ pictures;

special anastigmatic lens; f/32 to f/4.5; Supermatic shutter; Bulb, 1 to $\frac{1}{100}$ second; eye- and waist-level finders; revolving mount focusing; 3½ feet to Infinity

Special Features: The Supermatic shutter is this camera's special feature (other Vigilants can be obtained with Diomatic or Kodamatic shutters); delayed action; field case and strap available

Comment: The body of the camera is built for ease of operation and its quick-action shutter release and finder are most useful

Price: \$39.85 (other prices are: Diomatic f/8.8, \$15.50; Kodamatic f/4.5, \$26.50)



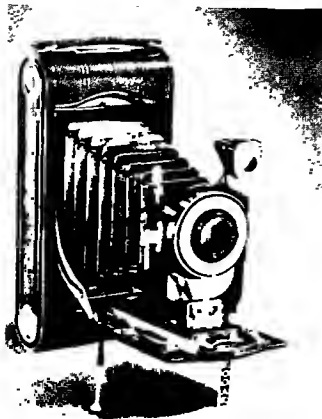
KODAK JUNIOR SIX-16, SERIES II

Facts: Folding roll film camera; 616 film roll; 2½ x 4½ pictures; fixed focus lens; 4 lens openings; Time and Instantaneous; waist- and eye-level finders

Special Features: Instead of having f-numbers, this camera rates openings as 1, 2, 3, 4

Comment: Extremely simple to run. One of the country's most popular cameras

Price: \$10.50



KODAK 3A, SERIES II

Facts: Folding roll camera; 122 roll film; 11 pictures of postcard

(3½ x 5½) size; 170mm anastigmatic lens; f/6.3 to f/45; Diodak shutter; Time, $\frac{1}{10}$ to $\frac{1}{100}$ second; waist-level finder; shifting draw-front focus; 6 feet to Infinity

Special Features: Rising front; cable release; available accessories such as direct-view wire finder and twin exposure back for split-size pictures

Comment: This camera takes big pictures which do not necessarily require enlarging. It is a good, steady camera—with the rising front feature an added help if high vertical pictures are to be taken

Price: \$55.75



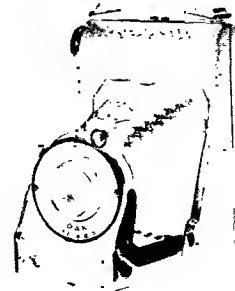
SUPERSPORT DOLLY

Facts: Folding camera; 120 or B2 roll film; 12 pictures of 2½ x 2½ or 16 of 1½ x 2½; 7.5cm Xenar lens; f/2.8 to f/16; Compur shutter; Time, 1 to $\frac{1}{100}$ second; eye-level sports finder; manual focusing; 10 feet to Infinity

Special Features: Delayed action; depth of field guide; other lenses available

Comment: A good small folding camera with precision lens

Price: With Xenar f/2.8, \$55.00
Distributor: Burleigh Brooks, New York



KODAK VIGILANT JUNIOR

Facts: Same as Vigilant Six-20, but fixed focus

Price: Six-20 is \$9.50

CAMERAS FOR ALL PURPOSES

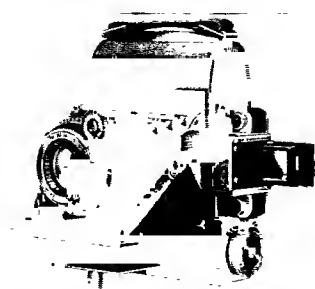
(Continued from page 576)

The twin-lens reflex has become increasingly popular with news photographers as well as free lancers who are doing photography for magazines and newspapers. These cameras are light, compact, and give excellent picture results. Focusing is quick and accurate. The roll film usually makes twelve $2\frac{1}{4} \times 2\frac{1}{4}$ negatives. (See also article on *Reflex Cameras, Twin-Lens cameras.*)

7. THE SINGLE-LENS REFLEX CAMERAS

The reflecting cameras in this group include the Graflex, Primarflex, Korelle-Reflex, and Exakta B. These cameras have only one lens which throws the image upon a 45° mirror, the mirror reflecting and reversing the image onto a groundglass which is the same size as the negative area. The image is right side up on the groundglass which is protected by a hood from direct outside light.

These cameras are larger and heavier than the miniature cameras. One disadvantage in some is that focusing is done with the lens wide open, then a moment is taken to stop the lens down, and then to frame the picture on the groundglass and snap the shutter. Sometimes by stopping the diaphragm down too far the image becomes quite indistinct. However, the new Super D Graflex cameras are available with automatic diaphragm adjustment. (See also article on



SUPER IKONTA A SPECIAL

Facts: Auto-focusing folding camera; 120 or B2 roll film; 16 pictures of $1\frac{3}{4} \times 2\frac{1}{4}$; 7.5cm Tessar lens; f/3.5 to f/22; Compur-rapid shutter; Bulb, 1 to $\frac{1}{1000}$ second; Albada eye-level finder; coupled focusing; 4 feet to Infinity

Special Features: Body release
Comment: This differs from the Ikonta A Special only in that it has the coupled range finder. Such an accessory is a guarantee of better pictures, however
Price: \$129.00

Distributor: Carl Zeiss, New York



SUPER KODAK SIX-20

Facts: Auto-focusing folding camera; 620 roll film, $2\frac{1}{4} \times 3\frac{1}{4}$ picture; anastigmatic special 100mm lens; f/3.5 to f/22 with diaphragm controlled by photoelectric cell; shutter synchronized with diaphragm; Time, 1 to $\frac{1}{1000}$ second; split field finder combined with view finder; 4 feet to Infinity

Special Features: Light-measuring photoelectric cell coupled with shutter and automatically adjusting diaphragm; one-piece range and view finder; lever winds film and sets shutter; self-timer

Comment: This amazing invention combines the photoelectric exposure meter with the camera and eliminates much guess work. The automatic diaphragm setting does not work for speeds below $\frac{1}{100}$ second. And it may be dispensed with entirely by cocking the lever only halfway—if normal camera operation is desired

Price: \$240.00

Reflex Cameras for a further consideration of this type.)

8. THE SHEET-FILM PACK CAMERAS

For many years the small hand camera with the groundglass back for focusing has been in use. These cameras include the Zeiss Maximar, Bee Bee, Kodak Recomar, Zeiss Ideal B, and Ihagee Duplex.

These sheet-film pack cameras have benefited by the development of the lens-coupled range finders which are available. The result was that photographers could have advantages similar to the small miniatures equipped with built-in range finders. These cameras are also popular with flash equipment.

9. VIEW AND STUDIO CAMERAS

These view cameras are designed for advanced photography and especially for commercial work. Such cameras are manufactured by Agfa, Eastman, Folmer Graflex, and other firms. Film sizes range from 4×5 to 8×10 inches. Other view cameras include the Linhof, Zeiss Universal Juwell, and Deardorff. Some of the advantages of the view cameras include a groundglass which permits accurate focusing and double and triple extension bellows for close-up pictures. Some view cameras have swing adjustments for correcting perspective. Also the revolving back is convenient in making vertical and horizontal views. (See survey on *View Cameras*).

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AGFA MEMO

Facts: 35mm miniature; double-frame model; 35mm cartridge; 24 pictures of $1 \times 1\frac{1}{2}$ inches; 25mm anastigmatic Memar lens; $f/22$ to $f/3.5$; pre-set leaf shutter; Time, $\frac{1}{2}$ to $\frac{1}{200}$ second; optical eye-level finder; manual focusing; $3\frac{1}{2}$ feet to Infinity

Special Features: Film counter; rapid film-winding slide at back of camera; depth of field scale; accessory clip for attaching flash units, etc.

Comment: The Memo is available in 5 models: the double-frame $f/3.5$, $f/4.5$, $f/5.6$; the single-frame $f/3.5$, $f/4.5$. The rapid winder and depth of field scale are very useful—also the accessory clip. A good inexpensive miniature

Price: \$37.00 (other models down to \$15.50)



ARGUS A2

Facts: 35mm miniature camera; 35mm cartridge film; pictures of $1 \times 1\frac{1}{2}$ inches; anastigmatic lens; $f/4.5$ to $f/18$; Time, $\frac{1}{2}$ to $\frac{1}{200}$; optical eye-level view finder; zone focusing

Special Features: Built-in extinction exposure meter; exposure guide

Comment: The Argus A is an extremely simple camera without exposure meter. The addition, in the A2, is an added convenience. Argus Models AA and C3 have built-in contacts for synchroflash photography. These cameras only require the use of an additional battery case which clips into the built-in camera synchronizer sockets. The DeLuxe case for the Argus Model AA can be left on the camera when the flash unit is attached

Price: \$15.90; Argus A is \$13.25

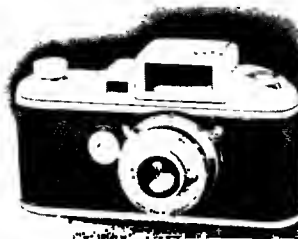


ARGUS A3

Facts: Same as Argus Colorcamera except with built-in extinction exposure meter

Comment: For photographers who find the extinction type almost as satisfactory as the photoelectric meter, this camera will prove as efficient as the more expensive Colorcamera

Price: \$23.85



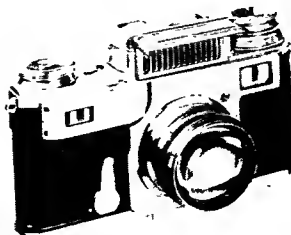
ARGUS CC COLORCAMERA

Facts: 35mm miniature camera; 35mm cartridges; $1 \times 1\frac{1}{2}$ -inch pictures; anastigmatic lens; $f/4$ to $f/16$; Argus shutter; Time, $\frac{1}{2}$ to $\frac{1}{200}$ second; optical eye-level finder; helical focusing; 15 inches to Infinity

Special Features: Built-in photoelectric exposure meter

Comment: Although called a color-camera, this is no more particularly suited for Kodachrome than for black and white. This is a fast lens for the money. And that built-in meter saves the bother of carrying two instruments

Price: \$35.50



CONTAX III (See article on Contax)

Facts: 35mm miniature camera; 35mm cartridge spool; $1 \times 1\frac{1}{2}$ pictures; available lenses are Tessar $f/3.5$, Tessar $f/2.8$, Sonnar $f/2$, Sonnar $f/1.5$; metal focal plane shutter; Time, $\frac{1}{2}$ to $\frac{1}{250}$ second;

eye-level finder in one piece with coupled focuser

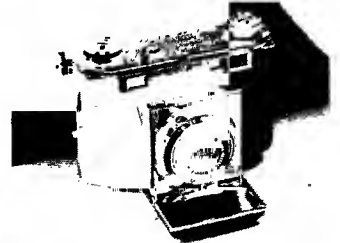
Special Features: Delayed action; 15 interchangeable lenses; built-in exposure meter which shows proper aperture and speed at glance; combined range and view finder; removable back; depth of field guide

Comment: This is a highly precise instrument and excellent for the advanced miniature cameraman.

Contax II comes without meter

Price: \$198.00 without lens; \$252.00 with $f/3.5$; \$399.00 with $f/1.5$ (Contax II is \$357.00 with $f/1.5$)

Distributor: Carl Zeiss, New York



SUPER DOLLINA

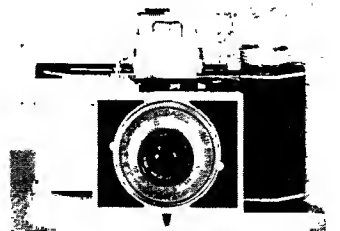
Facts: 35mm miniature camera; 35mm cartridge spool; pictures of $1 \times 1\frac{1}{2}$; 50mm Xenar lens; $f/2.8$ to $f/16$; Compur rapid shutter; Time, $\frac{1}{2}$ to $\frac{1}{200}$ second; optical eye-level view finder; coupled range finder; 3 feet to Infinity

Special Features: Depth of field table; parallax adjustment

Comment: Miniatures such as this one with a closing front have special advantages of compactness and protection of the lens. This is a reasonable buy

Price: With Xenar $f/2.8$, \$80; with Xenon $f/2$, \$95.00

Distributor: Burleigh Brooks, New York



KODAK BANTAM $f/4.5$

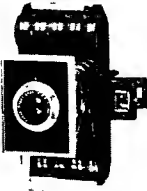
Facts: Miniature camera; bantam film; 8 pictures of $1\frac{1}{2} \times 1\frac{1}{2}$; anastigmat special 47mm lens; $f/4.5$ to $f/16$; Time, $\frac{1}{2}$ to $\frac{1}{200}$ second; optical eye-level finder; manual focusing; $2\frac{1}{2}$ feet to Infinity

Special Features: Bantam size film, an adaptation from the 35mm film

Comment: This stands at the head of the Bantam family, a precision

CAMERAS FOR ALL PURPOSES

miniature. Other models are fixed focus (f/8 and f/6.3) and a fourth focuses an f/5.6 lens
 Price: \$25.00 (f/8 is \$4.50; f/6.3, \$9.00)



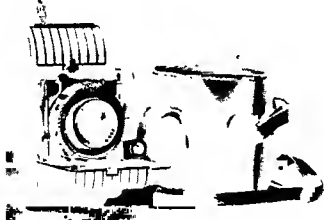
KODAK BANTAM f/5.6

Facts: Miniature camera; bantam film; 8 pictures of 1 1/4 x 1 1/4 inches; anastigmatic 50mm lens; f/5.6 to f/16; multiple-speed shutter; Time, 1/100 to 1/1000 second; optical eye-level finder; manual focusing; 4 feet to Infinity

Special Features: Bantam size film, molded camera body

Comment: This is one of the Bantam family, the others being: the focusing f/4.5; fixed focus f/8 and f/6.3

Price: \$14.50



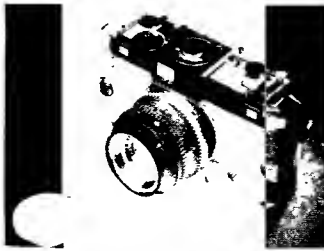
KODAK BANTAM SPECIAL

Facts: Miniature camera; bantam roll film; pictures of 1 1/4 x 1 1/4; 45mm Ektar lens; f/2 to f/16; Supermatic shutter; Time, 1 to 1/1000 second; optical eye-level view finder; coupled split field range finder

Special Features: Coated lens (coating of 1/100,000 inch on inner glass-air surfaces) giving more speed and accuracy; range finder adjustable to eyesight; infrared compensation on range finder; leather case as standard equipment

Comment: This camera has many new features which should interest photographers—particularly the coated lens. It is also good to see the field case coming in as standard equipment. The Kodak Bantams f/8, f/6.3, f/5.6, f/4.5 and the Bantam Special represent a line of miniature cameras ranging in price from a few dollars up to the Bantam Special price of over \$100.00

Price: \$116.75



KODAK EKTRA

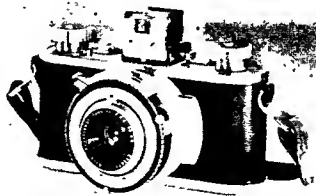
(See Ektra article)

Facts: 35mm miniature camera; cartridge spools; pictures of 1 x 1 1/2 inches; surface-treated 50mm Ektar lens (5 others available); f/1.9 to f/22; focal plane shutter; Bulb, 1 to 1/1000 second; eye-level split field coupled range finder; coupled focusing; 1 1/2 feet to Infinity

Special Features: 5 available (50mm, 35mm, 90mm, 135mm, and 153mm) interchangeable lenses adjustable to view and range finder; variable power view finder; individually-adjusted range finder; accessory bracket; infrared index; depth of field scale; delayed action; safety slide for back; accessory backs; film-type indicator; film advance lever; rapid rewinding; lens lock; close-up focus; double exposure control; automatic parallel adjustment

Comment: The Ektra accommodates numerable accessories, all of which are discussed in the Ektra article

Price: \$373.50 (\$304.00 with f/3.5 lens)



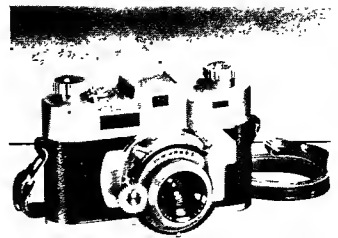
KODAK 35

Facts: 35mm miniature camera; cartridge spools; 36 pictures of 1 x 1 1/2 inches; anastigmatic 50mm lens; f/3.5 to f/16; Kodamatic focal plane shutter; Time, 1/100 to 1/1000 second; split field finder; manual focusing; 4 feet to Infinity

Special Features: Double exposure prevention; delayed action; stationary lens tube

Comment: If the miniature camera photographer has tastes which run to moderately priced miniatures, this is excellent. Comes also in f/4.5 and f/5.6 model. Also f/3.5 with coupled range finder

Price: \$35.50 (f/5.6 is \$15.50)



KODAK 35, FOCUSING

Facts: Same as Kodak 35, but with coupled range finder.

Comment: The range finder adds some \$15 to the price of this camera. For careful and close-up work, this extra is worth it

Price: \$50.50



LEICA IIIb (See also article on Leicas)

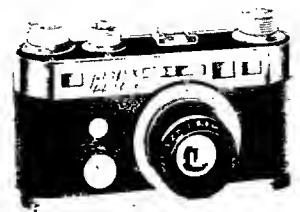
Facts: 35mm miniature camera; 35mm cartridge; 1 x 1 1/2 pictures; 50mm Leitz Xenon lens; f/1.5 to f/9; focal plane shutter; Time, 1 to 1/1000 second; optical eye-level finder; lens-coupled focusing; 3 1/2 feet to Infinity

Special Features: Individual vision focus adjustment; interchangeable lenses; depth of field scale

Comment: The accessories available for a Leica are far too numerous to mention. Shown here is the special base plate for rapid winding. An excellent precision miniature

Price: \$412.80 (without special base plate)

Distributor: E. Leitz, Inc., New York

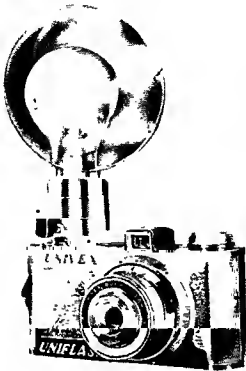


PERFLEX FIFTY FIVE

Facts: 35mm miniature camera; 35mm cartridge spool; 1 x 1 1/2-inch pictures; 50mm Sciencar anastigmat; f/2.8 to f/32; focal plane adjustable slit shutter; Time, 1 to

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$\frac{1}{100}$ second; one piece view and coupled range finder; split image range finder; $3\frac{1}{2}$ feet to Infinity
Special Features: One piece view and range finder; built-in extinction exposure meter; built-in flash synchronizer; interchangeable lenses available; accessory clip; removable back for easy loading
Comment: A streamlined candid camera at a low price. A similar model, without some of the features, is the Perflex Twenty-Two
Price: \$69.50 with Wollensack f/2.8 lens
Distributor: Candid Camera Corp., Chicago



UNIFLASH

Facts: Miniature camera; Univex No. 00 roll film; 36 pictures of $\frac{1}{4} \times \frac{1}{4}$; Vitar 60mm lens; Bulb and Instantaneous; optical view finder; fixed focus

Special Features: Built-in flash-synchronizer

Comment: This camera is a miniature-type box camera. The flash unit is an added feature, getting quite common on boxes these days. And the film size is extra small (only special films available for this camera)

Price: \$5.50 complete with flash unit



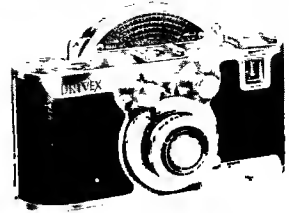
UNIVEX CORSAIR II

Facts: 35mm miniature camera; 35mm spools; pictures of $1 \times 1\frac{1}{2}$; 50mm anastigmatic lens; f/4.5 to f/16; between-the-lens shutter; Time, $\frac{1}{25}$ to $\frac{1}{200}$ second; optical eye-level view finder; manual focusing; 3 feet to Infinity

Special Features: Built-in extinction exposure meter; built-in flash synchronizer; exposure calculator dial; "filminder" (indicates kind and speed of film); safety lock against double exposure; self-retracting lens mount

Comment: This camera has an interesting feature in the built-in

meter and exposure calculator
Price: \$22.00; Corsair I is \$18.75



UNIVEX MERCURY

Facts: Miniature camera; Univex No. 00 roll film; 36 pictures of $\frac{1}{4} \times \frac{1}{4}$; Tricor 35mm lens; f/3.5 to f/22; metal focal plane shutter; Time, $\frac{1}{25}$ to $\frac{1}{1000}$ second; optical eye-level view finder; manual focusing; $1\frac{1}{2}$ feet to Infinity

Special Features: Built-in flash-synchronizer; depth of field scale; interchangeable lenses; accessory clip; exposure calculator; parallax adjustment

Comment: This camera has two particular features worth noting—the flash synchronizer and the fast speed. The flash synchronizer unit fits into two recessed terminals located on top of the camera. Two small pencil light batteries are used. This may be classed among miniatures of the middle price field.
Special Univex film required

Price: With f/2 lens and $\frac{1}{1000}$ second, \$29.75; with f/2 lens and $\frac{1}{500}$ second, \$65.00

10. SPECIAL CAMERAS

With constant development in photography, there has been a demand for more specialized types of cameras, such as the Big Bertha, Magic Eye, Camera Gun, medical, aerial, and astronomical cameras. Such cameras are not used by the average amateur photographer. More detailed information about the special cameras may be found in separate articles in this publication (See articles on *Big Berthas*, *Magic Eye*, *Camera Gun*, *Medical Photography*, *Aerial Photography*, *Astronomical Photography*).

MINIATURE CAMERA VERSUS LARGER CAMERA

Today there are two big photographic camps. One group extols the virtues of the miniature camera while the other group insists that there is nothing like a big camera $2\frac{1}{4} \times 3\frac{1}{4}$ or larger in size. Of course it is inter-

esting to have such positive opinions about one's own work. On the other hand every photographer should avoid getting into a single rut and method of doing his work. With the modern pace at which new photographic improvements are appearing, one should always have a tolerant attitude toward any basic photographic improvements. One should at least try them out.

It is true that the miniature camera has stimulated photography during the past decade. In fact the miniature cameras are responsible for many of our present-day camera habits, methods, and equipment. Take for example the emphasis on fine grain development. This all came about as a result of the 35mm camera. Today users of all cameras can benefit from the years of research in this particular field.

Naturally with over 200 different types of cameras to choose from, the average photographer must do a lot of selective thinking

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AGFA CLIPPER SPECIAL

Facts: Large miniature camera; PD16 roll film; 15 pictures of $2\frac{1}{8} \times 2\frac{1}{2}$; corrected anastigmatic lens; $f/22$ to $f/6.3$; leaf shutter; Time, $\frac{1}{2}$ to $\frac{1}{100}$ second; optical eye-level finder; manual focusing; 4 feet to Infinity

Special Features: Pull-out metal front of leak-proof construction; lens cap; depth of field scale
Comment: This is a sturdy version of the folding camera. A good camera and economical of film
Price: \$16.45



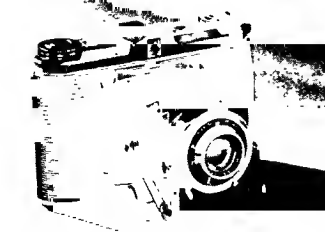
AGFA CLIPPER UNIFO

Facts: Large miniature camera; PD16 roll film; 15 pictures of $2\frac{1}{8} \times 2\frac{1}{2}$; double lens; leaf shutter; Bulb and Instantaneous; optical eye-level finder; fixed focus

Special Features: Pull-out metal front of leak-proof construction; shutter release guard

Comment: The pull-out front makes this a handy and compact instrument

Price: \$5.35



AGFA SPEEDEX

Facts: Large miniature camera; B2 roll film; 12 pictures of $2\frac{1}{8} \times 2\frac{1}{2}$; 85mm anastigmatic lens; $f/4.5$ to $f/22$; pre-set leaf shutter; Time, $\frac{1}{2}$ to $\frac{1}{100}$ second; optical eye-level finder; manual focusing; 3 feet to Infinity

Special Features: Self-erecting front platform; built-in cable release socket; central tripod socket; safety latch on back

Comment: This camera is a good buy and the film size is good for anyone, especially beginners. The central tripod socket is also useful for panoraming. A good camera in the low price field

Price: \$31.00 (fixed focus Junior is \$14.00)



FOTH DERBY II

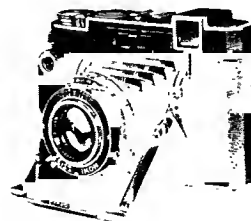
Facts: Large miniature camera; 127 or A8 roll film; 16 pictures of $1\frac{1}{8} \times 1\frac{3}{8}$; 2-inch Foth anastigmatic lens; $f/2.5$ to $f/36$; focal plane shutter; Bulb, $\frac{1}{2}$ to $\frac{1}{100}$ second; optical eye-level view finder; lens-coupled range finder; 2 feet to Infinity

Special Features: Two-zone range finder; delayed action; body shutter release

Comment: This excellent camera can be had for very little—a remarkable precision instrument in the low price bracket

Price: With $f/3.5$, \$34.00; with $f/2.5$, \$40.00

Distributor: Burleigh Brooks, New York



SUPER IKONTA B

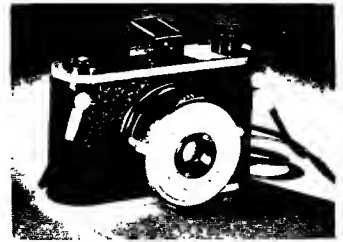
Facts: Large miniature camera; 120 or B2 roll film; 11 pictures of $2\frac{1}{8} \times 2\frac{1}{2}$; 8cm Tessar lens; $f/2.8$ to $f/11$; Compur rapid shutter; Bulb, 1 to $\frac{1}{100}$ second; one piece view and coupled range finder; 5 feet to Infinity

Special Features: Depth of field scale; hinged back; delayed action; self-timer; accessory clip; slide covering for counter window

Comment: This is one of the handy Ikonta cameras and all should be carefully compared for relative values and prices

Price: \$176.00

Distributor: Carl Zeiss, New York



KODAK DUEX

Facts: Large miniature camera; 620 film roll; 16 "split" pictures (half of the $2\frac{1}{8} \times 3\frac{1}{8}$ 620 size) of $1\frac{1}{8} \times 2\frac{1}{8}$; doublet lens in spiral-threaded lens tube; Bulb and Instantaneous; optical eye-level finder; fixed focus

Special Features: Lens tube; split type pictures; neck strap

Comment: A handy miniature, for very little

Price: \$6.50



KODAK MEDALIST

Facts: Large miniature; 620 roll film (520 film packs and 6.4×9 cm plates with adapter); pictures of $2\frac{1}{8} \times 3\frac{1}{8}$; Ektar 100mm lens; $f/32$ to $f/3.5$; Supermatic between-the-lens shutter; Time, 1 to $\frac{1}{100}$ second; eye-level split field range finder (groundglass focusing available); coupled range finder and focusing tube; 3 feet to Infinity
Special Features: Coupled depth of field scale; one-piece view and range finder; delayed action; automatic parallax correction; focusing correction for infrared; double exposure control; dial to show film in use; accessories are groundglass focusing, accessory back for cut-sheet film, film pack, plates

Comment: The Medalist is an extremely versatile camera and can be used in addition to the above, as an enlarger and for close-up work. It represents the latest in American-made camera improvements. For the advanced photographer who can make full and proper use of these remarkable aids

Price: \$176.00 without accessories

before buying the one camera which suits his particular needs. Therefore, let us continue our survey of cameras. Here are a few of the special points covering the miniature versus larger camera arguments:

1. Weight plays an important part. Miniature cameras are naturally lighter and easier to carry than the larger cameras. However, some people prefer the heavier cameras because of their steadiness.

2. Contact prints made from larger film are more practical than prints from 35mm negatives. However, the miniature camera contact prints are inexpensive and useful for index and identification purposes.

3. Choice of film emulsions is practically the same for all types of standard cameras. These emulsions are available in cut-sheet films, film packs, plates, and the familiar roll films.

4. The 35mm miniatures and most of the larger miniatures do not have the controls used for adjusting perspective. These controls are available on the larger cameras such as the Speed Graphic, Linhof, Recomar, etc.

5. Interchangeable lenses are available on some of the 35mm cameras as well as on the larger cameras. On the other hand there are many cameras with just the one fixed lens.

6. Usually the larger miniature and the larger cameras must be purchased when the groundglass focusing feature is desired. All view cameras have a groundglass as well as the Linhof, Speed Graphic, Graflex, Rolleiflex, etc.

7. Fine grain development is not quite so important when using the larger cameras. The smaller models especially the 35mm cameras require reliable fine grain film processing.

8. Miniature cameras such as the Contax, Ektra, and Leica have built-in lens-coupled range finders. With the development of the Kalart range finders, it is now possible to have the same feature on the larger cameras, including the Recomar, Bee Bee, Speed Graphic, Linhof, etc.

9. Undoubtedly one of the reasons for the increased popularity of the larger cameras has been the development of the modern speed flash synchronizers. With the flash synchronizer it is now possible to obtain wire

sharp pictures under all types of lighting conditions. Formerly the Contax or Leica with a high speed $f/2$ or $f/1.5$ lens was used.

10. The 35mm camera has a large film capacity ranging from 18 to 36 pictures. On the other hand some photographers prefer cameras with smaller film capacities. The cameras using cut-sheet film make it possible to expose one picture and then develop the negative immediately. Such cameras include the Maximar, Zeiss Juwell, Speed Graphic, the Bee Bee, and the Linhof. Of course the news photographer has developed his whole technic around the use of the Speed Graphic type of camera and the individual cut-sheet film holders. This makes it possible for him to make one or two exposures and then rush the film holder back to the newspaper office for development, by messenger.

11. The original popularity of the 35mm camera came with its small compact size. This permits quick use for taking candid pictures. This is why the small miniatures will continue to be very popular.

12. The use of 35mm color film has also added to the popularity of the 35mm camera. Color photography is more expensive for the larger camera sizes.

13. Some of the larger cameras are equipped with double extension bellows. This makes it possible to use these cameras when making close-up pictures.

14. On the other hand. The better 35mm cameras are available with almost *any* accessory—from the lens shade to the microscope attachment.

CAMERA PRICES

Cameras range in price all the way from the \$.50 box camera up to the super miniature camera which may cost \$300.00 or \$400.00—or more with the accessories. The price alone does not determine camera perfection. There are some very good buys among the \$10.00 to \$40.00 class of camera. Cameras in this group include the Agfa Speedex, Kodak 35, Kodak Monitor, Vigilant, and others. At the other end of the price scale we have the Contax, Ektra, and Leica cameras ranging in prices from \$150.00 to \$300.00.

Sometimes you can really get an excellent buy in used cameras. When buying used

CAMERAS FOR ALL PURPOSES



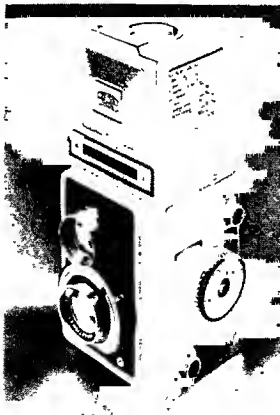
ARGOFLEX

Facts: Twin-lens reflex; 620 or PB20 roll film; $2\frac{1}{2} \times 2\frac{1}{2}$ pictures; 75mm Vorex anastigmatic lens; f/4.5 to f/18; Wollensak automatic shutter; Time, $\frac{1}{10}$ to $\frac{1}{200}$ second; groundglass and eye-level finders; manual focusing; 5 feet to Infinity

Special Features: Recessed lenses; f/4.5 focusing lens; magnifying glass on groundglass; eye-level view finder incorporated in reflex; depth of field guide

Comment: Many people want to see their picture on a groundglass before releasing the shutter. For those who do, this twin-lens reflex has many advantages

Price: \$44.50



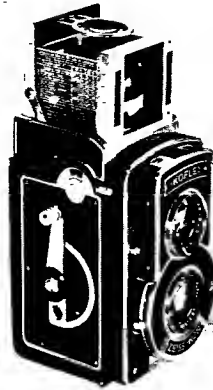
IKOFLEX I

Facts: Twin-lens reflex; 120 and B2 roll film; 12 pictures of $2\frac{1}{2} \times 2\frac{1}{2}$; 3-inch Novar anastigmatic lens; f/3.5 to f/16; Compur rapid shutter; Time, 1 to $\frac{1}{500}$ second; reflex groundglass finder and focus; 3 feet to Infinity

Special Features: Magnifier in groundglass; depth of field guide
Comment: This is the simplest of the Ikoflexes

Price: \$72.00

Distributor: Carl Zeiss, New York



IKOFLEX III

Facts: Twin-lens reflex; 120 and B2 roll film; 12 pictures of $2\frac{1}{2} \times 2\frac{1}{2}$; 8cm Tessar lens; f/2.8 to f/22; Compur-rapid shutter; Time, 1 to $\frac{1}{500}$ second; groundglass and optical eye-level finder; groundglass focusing; 3 feet to Infinity

Special Features: Groundglass magnifier covers whole image; optical eye-level sports finder in hood; with parallax correction; f/2.8 finder lens; film winding lever; exposure tables; depth of field; speeds, distance, and aperture readings visible from above

Comment: This is the fastest of the small reflex cameras, with all of the features necessary and helpful for this type of instrument

Price: \$219.00

Distributor: Carl Zeiss, New York



ROLLEICORD

Facts: Twin-lens reflex; 120 or B2 roll film; 12 pictures of $2\frac{1}{2} \times 2\frac{1}{2}$; 7.5cm Triotar lens; f/3.5 to f/16; Compur shutter; Time, 1 to $\frac{1}{500}$ second; groundglass finder and focusing; 32 inches to Infinity

Special Features: Focusing magnifier; adaptability to cut-sheet film, plates, and miniature; depth of field guide; cable release; parallax adjustment; double lens cap

Comment: A moderately priced reflex, similar to the Rolleiflex
Price: With Triotar f/3.5, \$108.35; with f/4.5, \$83.60
Distributor: Burleigh Brooks, N.Y.



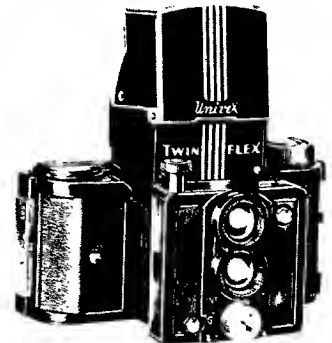
ROLLEIFLEX AUTOMATIC

Facts: Twin-lens reflex; 120 roll film; $2\frac{1}{2} \times 2\frac{1}{2}$ pictures; 7.5cm Tessar lens; f/3.5 to f/22; Compur rapid shutter; Bulb, 1 to $\frac{1}{500}$ second; groundglass view finder and focusing; 2 feet to Infinity

Special Features: Groundglass magnifier; delayed action; film winding lever; hyperfocal distance table; depth of field guide; parallax adjustment; adapters for cut-sheet film, plates, and 35mm film; regular equipment includes twin-lens cap and leather camera case
Comment: The Rolleiflex has always been a twin-lens favorite

Price: \$192.50

Distributor: Burleigh Brooks, N.Y.



UNIVEX TWINFLEX

Facts: Twin-lens reflex; Univex No. 00 roll film; pictures of $1\frac{1}{2} \times 1\frac{1}{2}$; fixed aperture; rotary shutter; Time and Instantaneous; reflex finder and focusing; 3 feet to Infinity

Special Features: Plunger-type shutter; distance scale
Comment: A focusing reflex box camera

Price: \$5.50

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camera equipment be sure to try out the camera first or get a reliable friend who can give you some expert advice on cameras. The highest priced camera can be practically worthless if it has been worn out and then placed on the shelves for resale. Be sure to check all vital parts, such as shutters, film carrier, bellows, lenses, etc.

All prices given in this equipment survey are naturally subject to change without notice, but give a good basis for comparison. Therefore, it is always important to check current prices with your photographic dealer or write directly to the manufacturers for catalogs.

Possibly you have never thought much about camera shutters, lenses, film carriers, view finders, range finders, and other parts of the camera separately. If you are really interested in understanding a camera, it is important to become familiar with the various parts which add so much to better operation. Starting with the simple box camera you have very few special attachments. Then as the higher price brackets are reached, you will find cameras with lens-coupled range finders, interchangeable lenses, special adjustments for rising fronts, etc.

CAMERA SHUTTERS

Various types of shutters are used with cameras. These shutters vary from the simplest box camera shutter to the high speed focal plane shutter. There are really two basic classes of shutters: 1. the front lens or between-the-lens type and: 2. the focal plane type.

The front lens shutters are divided into three groups: the rotary, the pre-setting, and the automatic. These *between-the-lens shutters* are mounted between the lens elements, or, in the case of simple single element lenses, either just in front or in back of the lens. On the other hand the focal plane shutters will always be found close to the film area in back of the camera. The Contax, Ektra, and Leica are typical focal plane cameras.

Focal plane shutters are of two types, the self-capping such as the Leica shutter and the curtain type with the variable slits as found in the Speed Graphic cameras. The main advantage of the self-capping type of

shutter is that it is impossible to make double exposures. On the other hand when using the Speed Graphic, the dark negative slide in the film holder must be replaced before the shutter is reset. Otherwise, if the shutter in the front lens is open, the picture will be ruined when resetting the graflex type of focal plane shutter.

The typical *rotary shutter* is made up of a thin metal part containing a small slit which is the width of the lens and a little longer. This type of shutter is to be found on the lower priced cameras such as the typical box camera. When the rotary shutter is released it snaps across the lens and at the same time permits light to pass through the lens during the brief interval of rotation. The shutter speed is determined by the length of the slot and also the speed in which it travels across the lens.

The automatic shutter is also known as a self-cocking shutter. In other words, it is not necessary to set the shutter before the exposure. As the release is pushed down by hand or by using the wire cable release, the shutter mechanism is set under tension and then toward the end of the stroke it is automatically released.

Before releasing this shutter it is possible to select any shutter speed. The automatic shutter is made up of special thin metal blades arranged in such a way that they stop light from entering the lens. These blades open up to make the exposure and then instantly close.

The Dakon shutter on Kodak cameras and the Readysset shutters on Agfa cameras are typical of automatic self-setting shutters.

A *pre-setting shutter* is similar in operation to the automatic shutter. This shutter has similar speed settings which are selected before the exposure. The difference is that a small pre-setting lever must be pushed down to cock the shutter. Then when the exposure is to be made the release lever is pushed. The difference between the automatic and pre-setting shutter is that the latter type has a much lighter release than the former.

Some of the typical pre-setting camera shutters are the Kodak Supermatic, Kodamatic, Diomatic, Ilex, and Compur, which are of the typical between-the-lens type.

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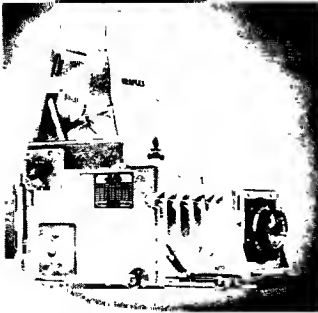


GRAFLEX, HOME PORTRAIT (See article in *Graphic and Graflex*)

Facts: Single-lens reflex; cut-sheet, roll, pack, and plates; 5 x 7 pictures; interchangeable lenses up to 10 inches; $f/3.5$ to $f/45$; focal plane shutter; Time, 1 to $\frac{1}{500}$ second; groundglass view finder and focusing

Special Features: Variable split tension shutter; interchangeable lens board; rising, lowering, and tilting lens front; 14-inch bellows
Comment: This is definitely a professional camera, designed especially for fine portraits. This camera also serves as the basic instrument of the Big Berthas

Price: Without lens \$265.75; with Kodak $f/4.5$, \$391.10



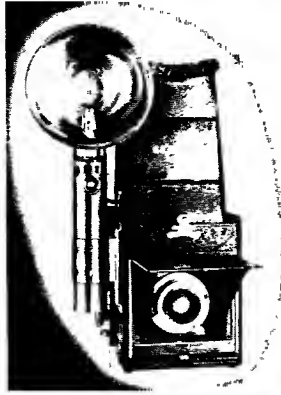
GRAFLEX, RB AUTO (See article on *Graphic and Graflex*)

Facts: Single-lens reflex; cut-sheet, roll, pack, and plates; pictures of $3\frac{1}{2} \times 4\frac{1}{2}$; 7 to 17-inch lenses available for $3\frac{1}{2} \times 4\frac{1}{2}$; focal plane shutter; Time, $\frac{1}{2}$ to $\frac{1}{500}$ second; groundglass view finder and focusing; 1:1 working distance

Special Features: Viewing mirror snaps up automatically as shutter is released; bellows extension to 1:1 reproduction ratio; revolving back; rising front

Comment: This is a heavy, solid camera and a favorite of many—for advanced amateurs and professionals

Price: $3\frac{1}{2} \times 4\frac{1}{2}$ with $f/4.5$, \$188.25



GRAFLEX RB SUPER D (See article on *Graphic and Graflex*)

Facts: Single-lens reflex; cut-sheet, roll, pack, and plates; pictures of $3\frac{1}{2} \times 4\frac{1}{2}$ or 4×5 ; 6 $\frac{1}{2}$ -inch anastigmatic lens; $f/4.5$ to $f/32$; focal plane shutter; $\frac{1}{2}$ to $\frac{1}{500}$ second; groundglass view finder; 23 inches to Infinity

Special Features: Built-in lens shade; revolving back; provision for cut-sheet film, roll film, packs, and plates; varying slit in shutter; interchangeable lens board (17 focal lengths are available in lenses); 8 $\frac{1}{2}$ -inch bellows capacity for $3\frac{1}{2} \times 4\frac{1}{2}$, 12 for 4×5 ; built-in flash for G. E. SM flashlamps; Korling automatic pre-setting diaphragm

Comment: Here is an excellent large camera for the serious photographer

Price: \$166.50 for $3\frac{1}{2} \times 4\frac{1}{2}$ with Kodak anastigmat $f/4.5$ lens and automatic Korling diaphragm control



KINE EXAKTA

Facts: 35mm miniature and single-lens reflex; 35mm cartridge spool; 1 x 1 $\frac{1}{2}$ -inch pictures; 5cm Meyer lens; $f/1.9$; focal plane shutter; 12 seconds to $\frac{1}{500}$ second; groundglass reflex view and range finder; 3 feet to Infinity

Special Features: Delayed action; built-in flash synchronizer; hyper-focal distance table; depth of field guide

Comment: This single-lens reflex in the 35mm size is almost unique. This camera comes with a variety of lenses of the Zeiss, Meyer, Schneider, and Ihagee types

Price: From \$120.00 to \$270.00



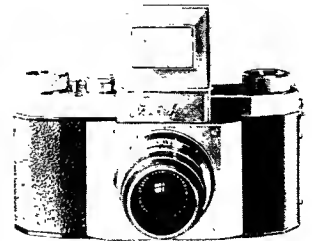
NATIONAL GRAFLEX (See article on *Graphic and Graflex*)

Facts: Single-lens reflex; 120 roll film; 10 $2\frac{1}{2} \times 2\frac{1}{2}$ pictures; 3-inch Tessar lens; $f/3.5$ to $f/22$; focal plane shutter; Time, $\frac{1}{2}$ to $\frac{1}{500}$ second; groundglass finder and focusing; 42 inches to Infinity

Special Features: No bellows; octagonal box-like appearance when completely folded; all controls except diaphragm on top panel; depth of field scale; exposure guide; focusing magnifier; self-timer

Comment: This reflex is advertised as "a mere handful." It is, in fact, extremely small and therefore handy to carry and operate

Price: \$97.75



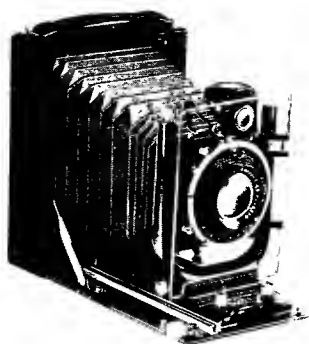
PRAKTIFFLEX

Facts: Single-lens reflex; 35mm cartridge; 1 x 1 $\frac{1}{2}$ -inch pictures; 50mm Schneider lens; $f/3.5$ to $f/16$; focal plane shutter; Bulb, $\frac{1}{2}$ to $\frac{1}{500}$ second; reflex groundglass view finder; helical focusing; $3\frac{1}{2}$ feet to Infinity

Comment: A reflex camera using miniature film, this is a very handy instrument—with no "frills"

Price: \$192.00 with $f/2$ Xenon
Distributor: Burleigh Brooks, N.Y.

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IDEAL B

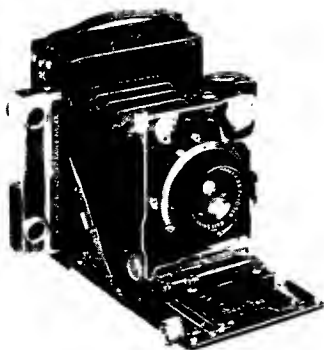
Facts: Sheet-film pack camera; film pack, cut-sheets, or plates; $3\frac{1}{2} \times 4\frac{1}{2}$ pictures; 5-inch Tessar lens; $f/4.5$ to $f/32$; Compur shutter; Time, 1 to $\frac{1}{100}$ second; waist-level brilliant finder and wire frame finder; manual focusing and groundglass

Special Features: Bayonet-type interchangeable lens; film pack adapters; groundglass adapter; drop bed; double extension bellows; rising and cross front; swing back; bubble level; delayed action; self-timing shutter

Comment: This is a good medium-priced camera and reliable in its field, with excellent lenses

Price: With 5-inch lens, \$120.00; with 6-inch lens, \$126.00

Distributor: Carl Zeiss, New York



BEE BEE A

Facts: Sheet-film pack camera; film pack, plates, and cut-sheet film; $2\frac{1}{2} \times 3\frac{1}{2}$ pictures; Tessar 10.5cm lens; $f/3.5$ to $f/32$; Compur rapid shutter; Time, 1 to $\frac{1}{100}$ second; waist-level brilliant and wire frame finders; groundglass focusing (illustration shows accessory lens-coupled Kalart range finder); $3\frac{1}{2}$ feet to infinity

Special Features: Adapters for film pack and plate holders; groundglass focusing back; cable release; delayed action; rise and fall of lens; horizontal front movements; double extension bellows; interchangeable lenses

Comment: This is a moderately priced hand camera, and a good instrument

Price: With rapid shutter and Tessar $f/3.5$, \$85.00; with Radianar $f/4.5$ and Compur shutter, \$42.00; coupled range finder \$27.00 extra

Distributor: Burleigh Brooks, New York



B & J PRESS, 4 x 5

Facts: Sheet-film pack camera; 4 x 5 cut-sheet film or plate; interchangeable lenses; shutter varies with lens; optical eye-level and groundglass finder; groundglass focusing with manual slide rule scale

Special Features: 14-inch double extension bellows; 20° drop bed; rack and pinion focusing; groundglass focusing panel; 2-inch front rise or tilt; $1\frac{1}{2}$ -inch sideways lens shift; 4 x 4 removable lens board; parallax correcting view finder; extreme light weight (4½ lbs.); spring back, suitable for film pack adapter; revolving back; available are coupled range finder, synchro-flash equipment, carrying case, viewing masks for varying lenses

Comment: As with other cameras of this type, there is a good camera body but a lot depends upon the lens used. These vary from the 6-inch $f/4.5$ anastigmat with self-cocking shutter and speeds of 1 to $\frac{1}{100}$ second—to the 3½-inch $f/12.5$ wide-angle with speeds of 1 to $\frac{1}{100}$ second

Price: Without lens \$49.50 ($f/4.5$ anastigmat is \$42.50; $f/12.5$ is \$31.50)

Distributor: Burke and James, Chicago



KODAK RECOMAR 18

Facts: Sheet-film pack camera; $2\frac{1}{2} \times 3\frac{1}{2}$ film packs, 6.4 x 9cm sheet and plates; anastigmatic lens; $f/4.5$ to $f/32$; Compur shutter; Time, 1 to $\frac{1}{100}$ second; waist-level and wire frame eye-level finders; rack and pinion focusing; 4 feet to infinity

Special Features: Rising and lowering front; double extension bellows; self-timer; spirit level; groundglass back

Comment: For the serious photographer, features like the double extension bellows, the groundglass back, and the rising front mean a great deal. This is a versatile camera, being capable of fast shooting, due to the "press" type of open finder. Accessories available are lenses, adapter back for 35mm. Recomars also come in the "33" model, which is $3\frac{1}{2} \times 4\frac{1}{2}$

Price: \$54.00 including plate and film holders, film pack adapter, cable release ("33" is \$63.00)



MAKINA II S

Facts: Sheet-film pack camera; cut-sheet film, roll, film pack, plates; pictures of $2\frac{1}{2} \times 3\frac{1}{2}$; Anticomar 4-inch lens; $f/2.9$ to $f/25$; Compur shutter; Time, 1 to $\frac{1}{100}$ second; blue monotone optical eye-level finder and wire frame finder with peep sight; coupled range finder and groundglass focusing

Special Features: Back adapters for all film types; interchangeable lenses; three methods of focusing (groundglass, rangefinder, distance scale); delayed action; monotone optical finder; light weight (28 oz.)

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Comment: In the same price range as the Leica and Contax, the Makina has almost as many available accessories. Lenses are numerous. A special focal plane shutter, film adapters, reproduction stands, extension outfits, projectors, etc. make this an extremely versatile hand and stand camera. **Price:** About \$250.00



SPEED GRAPHIC 2 1/2 x 3 1/2 (See article on Graphic and Graflex) **Facts:** Sheet-film pack camera; adaptable to roll, sheet, plate, and film pack; pictures of 2 1/2 x 3 1/2; 101mm Ektar lens; f/4.5 to f/32;

focal plane and between-the-lens shutters; Time, 1 to 1/1000 second; optical eye-level and wire frame finders; groundglass view finder and focusing; 6 feet to Infinity **Special Features:** Two-shutter tension control; interchangeable lenses; parallax correction; double extension bellows; drop bed; depth of field scale; provision for coupled range finder and flash synchronization; rising front; available are many film adapters, including dividing back, film pack adapter, plate, cut-sheet film holders, roll holders; delayed action; focal plane with 5 sizes of slits

Comment: The Speed Graphic comes in 4 sizes: the 2 1/2 x 3 1/2, 3 1/2 x 4 1/2, 4 x 5, and 5 x 7, and there are many accessories for each. The larger sizes have added features, such as laterally shifting front and revolving back. All, however, are extremely versatile and useful in news photography, scientific, industrial, pictorial, architectural, landscape, and action work. A well-known product **Price:** 2 1/2 x 3 1/2 with f/4.5 Ektar, \$127.50, others up to \$145.00; 3 1/2 x 4 1/2 from \$129.60 to \$213.00; 4 x 5 from \$138.65 to \$219.75; 5 x 7 from \$171.75 to \$209.10

99% of the time. Higher speeds of 70 to 80 miles per hour are only used in special emergencies.

When buying standard photographic equipment made by reliable manufacturers the shutters can be depended upon to operate successfully for many years. The Compur shutter has been available for a long time. Only recently the Kodak Company started manufacturing their very efficient Supermatic type of shutter. This latter shutter is very accurate and a good buy. (See article on *Shutters*.)

CAMERA LENSES

The story of lenses is covered very completely in later articles (See *Lenses*). As a camera buyer it is im-

portant to select a good lens. Naturally the low priced cameras have cheaper lenses although they may work very efficiently for making the average pictures. When you are interested in making photographs under difficult lighting conditions or it is necessary to obtain extremely sharp negatives, you must select one of the anastigmat type of lens. The box cameras are equipped with a meniscus lens which has an approximate lens speed of f/15. Some of the box cameras with focusing adjustments have a slightly faster lens, which averages about f/12.5. Then come the roll film folding cameras with focusing adjustments which have a lens speed average of about f/11. The higher priced roll film cameras have anastigmatic lenses ranging from f/8.8 to f/3.5. These lenses are provided with an iris type of diaphragm. The scale for the iris diaphragm appears on the lens mount where it is readily accessible for use.

These shutters have speeds ranging from Time to 1/100 second. Right here is where one of the main differences come in relation to the faster focal plane type of shutters. The main difference between the front between-the-lens type of shutter and the focal plane type is in the range of speeds. Some of the focal plane shutters have speeds ranging from Time to 1/1250 second. Thus for high speed work it would be necessary to purchase one of the focal plane cameras. On the other hand there are more flash synchronizers available for the between-the-lens type of shutters. In case you are planning to buy a Speed Graphic camera, the Kalart Sistogun is recommended for use with the focal plane shutter.

As the majority of photographs are made with shutter speeds ranging from Time to possibly 1/100 of a second, it is not always essential that you buy a camera with a focal plane shutter for the top speeds. However, many photographers feel better if they have a camera which is capable of using these top speeds in an emergency. It's just like owning a high powered automobile and driving it at an average of 40 to 50 miles per hour

important to select a good lens. Naturally the low priced cameras have cheaper lenses although they may work very efficiently for making the average pictures. When you are interested in making photographs under difficult lighting conditions or it is necessary to obtain extremely sharp negatives, you must select one of the anastigmat type of lens. The box cameras are equipped with a meniscus lens which has an approximate lens speed of f/15. Some of the box cameras with focusing adjustments have a slightly faster lens, which averages about f/12.5. Then come the roll film folding cameras with focusing adjustments which have a lens speed average of about f/11. The higher priced roll film cameras have anastigmatic lenses ranging from f/8.8 to f/3.5. These lenses are provided with an iris type of diaphragm. The scale for the iris diaphragm appears on the lens mount where it is readily accessible for use.

CAMERA FINDERS

All cameras with the exception of the view cameras have some kind of view finder which is used for locating the picture area to

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be photographed. There are various types of view finders: 1. the groundglass finder; 2. brilliant finder; 3. optical direct vision finder; 4. the wire frame finder. These finders are really the essential camera eyes.

The view finder is placed as close to the camera lens as is practical, in order to include the same field of view. There is a slight variation from the actual picture made on the film and the view finder. This occurs

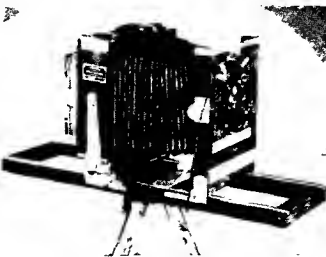


AGFA 5 x 7 STUDIO

Facts: Studio camera; cut-sheet film and plates; 5 x 7 or half 5 x 7; interchangeable lens board; groundglass focusing

Special Features: Interchangeable lens board makes all kinds of lenses possible; 17-inch double extension bellows; rack and pinion focusing; double tripod sockets; built-in sliding groundglass back; swing back

Comment: These cameras come without specific lenses and are very simple in design, sturdy and dependable in action. This Agfa camera comes in three models—mahogany, ebony, and metallic
Price: Without lens, \$75.00



CROWN 4 x 5 VIEW CAMERA

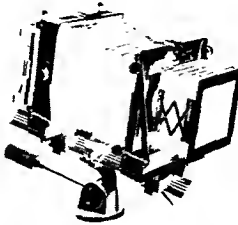
Facts: View camera; cut-sheet film and plates; 3 1/4 x 4 1/4 or 4 x 5 pictures; interchangeable lens board of 4 x 4; groundglass focusing; 3 1/2 inch to Infinity

Special Features: Interchangeable backs; interchangeable lens board; 19-inch double extension bellows; back and front rack and pinion focusing; use of Graphic type holders; swing adjustments—front rise, 1 inch; front fall, 1 1/2 inch; lateral front shift, 1 1/2 inch; back swing, 12°; back tilt, 12°

Comment: This camera has most of the swing adjustments necessary for careful studio and architectural work. A lens of at least 4-inch focal length is necessary. Everything the advanced photographer should need

Price: Without lens, \$65.25

Distributor: Folmer Graflex



GRAPHIC VIEW (See article on Graphic and Graflex)

Facts: View camera; cut-sheet film and packs; 4 x 5 pictures; interchangeable lens board; groundglass focusing

Special Features: Front rises, tilts, shifts; reversible back; 12 1/2-inch bellows extension; spirit level; V-section aluminum bed; pan-tilt tripod head attached; Graphic and Graflex backs adaptable

Comment: An all-metal view camera, this one has the comparatively new type of camera bed. An excellent camera in the medium price field

Price: \$104.00 without lens; \$16.00 more with accordion lens shade shown



LINHOF STANDARD 5 x 7

Facts: View camera; cut-sheet film, plates, film pack; 5 x 7 pictures (other models are 4 x 6 and

3 1/4 x 4 1/4); compound shutter; Time, 1 to 1/100; wire frame or groundglass view finder; groundglass focusing

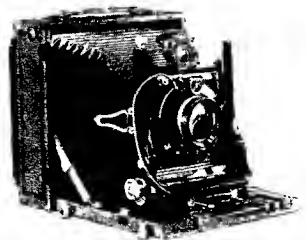
Special Features: Compur shutter available at 1/200 second; 14-inch bellows draw; parallax adjustment; 20° drop bed; 15° backward lens tilt; 1/4-inch horizontal lens movement; 2 1/2-inch vertical lens movement; 2 levels; 2 tripod bushes; interchangeable lenses; revolving back; available are hooded groundglass back, focal plane shutter, film adapters as extra accessories

Comment: This camera comes in a variety of film sizes and with many available lenses. It is an excellent combination of the good features of the view and film pack camera—and used by many experienced and good photographers throughout the country

Price: 5 x 7 without lens, \$272.25; with f/4.5, \$385.00

3 1/4 x 4 1/4 without lens, \$187.00; with f/3.5, \$258.50

4 x 6 without lens, \$231.00; with f/4.5, \$302.50



UNIVERSAL JEWEL B

Facts: View camera; cut-sheet film and plates; 5 x 7 pictures, 21cm Tessar lens; f/4.5 to f/45; compound shutter; Time, 1 to 1/100 second; waist-level finder; groundglass focusing

Special Features: 19-inch bellows extension; rising and falling front; tilting lens board; cross front adjustments; detachable lens board; bubble level

Comment: The Jewel has no back adjustments, but all the front adjustments necessary. Available are various types of lenses and shutters. This gives a satisfactory large negative

Price: \$354.00

Distributor: Carl Zeiss, New York

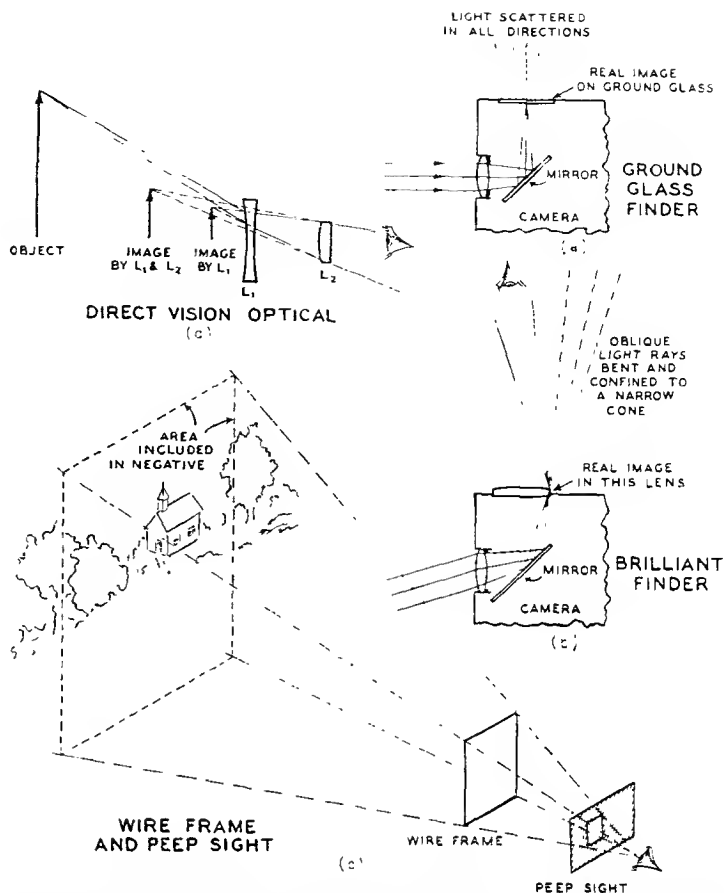
CAMERAS FOR ALL PURPOSES

only at distances under 15 or 20 feet. Beyond this distance the variation between finder and film area becomes negligible. Therefore, to make better corrections for close-ups, some of the finders have what is known as parallax adjustment. This provides a slight tilting of the direct view finder to bring it in line with the close-up object.

With the continued development in photographic products, we find many refinements of the basic groundglass type of reflecting view finder which is provided in most of the box cameras. These view finders have been built into the basic body of the camera. Also, some of them are in combination with the built-in coupled range finders. This added convenience gives the photographer an opportunity to watch the subject to be photographed and at the same time adjust the lens for sharp focus. Usually the field of the finder is slightly smaller than the actual field seen by the camera lens. This is just an added precaution in order to include the entire field.

The Reflecting Ground-glass Finder which is used on the Agfa Cadets and Junior Box Brownies is made up of a short focal length finder lens, a reflecting mirror, and the groundglass which receives the reflected image from the small view finder lens. This is an erect image (not upside down) as seen on the groundglass of the view finder. However, the image is reversed from left to right.

The reflected image in the groundglass finder must be small. Also the depth of field must be as great as possible to make the reflected image in the finder look sharp for any



VIEW FINDER SYSTEMS. The groundglass finder (a) is found on most box cameras and consists of a simple lens, mirror, and groundglass. The image, with this, is reversed from left to right. The brilliant finder (b) consists of two lenses and the image, when viewed from directly above, is more brilliant than on the groundglass due to a concentration of the light beam. The peep sight finder (c) is extremely simple and very useful, as it gives a direct sight and can be used for fast action work. The direct vision optical finder (d) is used at eye-level and gives a brilliant image the right way up and right way round. This consists of a negative lens with a positive lens about 1 inch behind it—and the two lenses may be either collapsible or at either end of a tubular pseudo-telescope

Drawing, Eastman Kodak Company

distance. This is why the short focal length lens is used in this type of finder.

The Brilliant Reflecting Finder has a special lens in place of the ordinary groundglass type of finder. This brilliant type of finder is more efficient in conserving a reflected light image. In this way the image appears to be brighter than provided by the groundglass finder. The light reflected to the photographer's eye covers a narrow cone which has a diameter of $3\frac{1}{2}$ inches at 1 foot above the finder. This makes it necessary for the photographer to keep his eyes directly over

the finder in order to obtain the full brilliance provided. The Six-20 and Six-16 Brownies and many of the roll film folding Kodaks as well as the Agfa Viking, Maximar, Kodak Monitors, and other cameras are provided with brilliant view finders. These finders are used below eye level, and are often referred to as waist-level finders.

Direct vision, wire frame, and peep sight finders are used very extensively on many cameras, such as the Linhof, Speed Graphic, Argus, Leica, Contax, Zeiss Ideal, Super Ikonta Cameras, Kodak Monitors, Vigilants, and many others. Some cameras have a combination of direct view finder, peep sight finder, or the wire frame finder.

When using finders of the direct type, the camera is held at eye level with the eye close to the rear peep sight of the finder. Pictures made from eye level appear to be more natural. For this reason more cameras are using the eye level type of finders. Another advantage for the direct vision finder is that the field of view seen in the finder is right side up and not reversed from left to right. This helps especially when following fast moving objects in a direct view finder.

The *optical direct vision finder* which is used on the Contax, Leica, Kodak 35, Ektra, and others is made up of a negative lens, which creates a virtual image in front of the lens, and a positive lens which projects this virtual image to a point about 15 feet from the eye. As the average human eye focuses easily on any object 15 or more feet away, this point of the virtual image is convenient. The optical direct vision finder is really a small telescope in reverse, giving a reduced image instead of the usual magnified image. Some optical direct vision finders are provided with a parallax adjustment near the rear elements. This provides for easy re-alignment of the view finder with the subject at closer distances.

The *Wire Frame Finder* is used on press cameras such as the Speed Graphic, Linhof, B & J Press camera, and others. The front wire frame has the same area as the film dimensions. The rear peep sight keeps the eye in the most advantageous position while viewing the subject. Some of these peep sights have parallax adjustments for extreme close-up work. The wire frame

finder is particularly useful when following rapidly moving objects.

FOCUSING AND DEPTH OF FIELD SCALE

Most cameras have focusing scales which show various distances up to 100 feet and a point known as infinity. This distance scale may be seen on the focusing bed of the ordinary camera or the ring mount. When the subject is close to the camera the lens is moved away from the film. It is important to determine the correct distance between the subject and the camera and adjust the focusing scale accordingly. To do this a range finder is essential. However, with practice it is possible to guess distances when subjects are 10 feet or more away from the camera when critical sharp focus is not required. Close distances can be measured with a tape line when necessary.

When we talk about depth of field we really mean the distance between the closest object which is in sharp focus and the farthest object in sharp focus.

IN CONCLUSION

This camera survey covers the important camera models available today. In a few cases some of the important cameras may not be available. However, these cameras are always to be found in good used condition in case new equipment cannot be purchased.

The average serious photographer usually ends up by owning two or three cameras, one of them may be a good 35mm miniature, the next may be a small reflex camera, and as a third camera either a view camera or something of the Speed Graphic type. To start with it is not necessary to buy a box camera. You can learn the fundamentals of photography with a good camera right from the start. If you have had no previous camera experiences, my advice would be to start with one of the larger miniature cameras or even a roll film folding type camera. With such equipment you can quickly carry out most of your camera ideas.

The main thing is to get your camera and any other basic equipment—not too many gadgets at first. Then learn to handle this equipment and take pictures—lots of them. That is the only way to test your skill and to get the most out of your new outfit.

JULIA MARGARET CAMERON

JULIA MARGARET CAMERON

Dr. Heinrich Schwarz

*Author of David Octavius Hill and other books
on art, Albright Art Gallery, Buffalo*

Julia Margaret Cameron took up photography when she was nearly fifty and attained such remarkable success in the nineteenth century that she is today recognized as one of photography's great. She developed a style of her own that gained for her the name of "a Whistler of photography."

See Also History of Photography

JULIA MARGARET CAMERON was born in India on June 11, 1815—the third daughter of the Bengal civil servant James Pattle and his French born wife. In 1838 she married Charles Hay Cameron, fourth member of the Council of Calcutta. Ten years later she moved to England with her family. They first settled in London, later in Putney, and in 1860 in Freshwater Bay (Isle of Wight). In 1875 the couple returned to India. Mrs. Cameron died in Ceylon on January 26, 1879.

PHOTOGRAPHIC WORK

In about 1863 J. M. Cameron turned her attention to photography, after she had received a camera and photographic equipment from one of her married daughters. The portrait of a young girl, dated 1864 is inscribed: "Annie, my first success" (Collection of the Royal Photographic Society, London). Between 1864 and 1875, especially in the 60's, Cameron produced her photographic work consisting of great portraits as well as allegorical, religious, illustrative, and genre pictures. In Ceylon, too, she continued her photographic activity.

"Dimbola," Cameron's house in Freshwater Bay, was the center of a select circle comprising many outstanding scientists, poets, painters, and actors of the middle Victorian era. Alfred Lord Tennyson, whose house was in the vicinity of Cameron's home, Sir John F. W. Herschel, Sir Henry Taylor, Thomas Carlyle, Charles Darwin, Henry Wadsworth Longfellow, Robert Browning, Joseph Joachim, Ellen Terry, and many others were members of her circle. All these friends were photographed by Cameron, a

great number of them more than once. Sir Henry Taylor, one of her favorites, is said to have been portrayed by Cameron at least fifty times. These unusually large portraits, mostly heads or half-length pictures but never full-length pictures, are, beside the works of Hill and Adamson, the most precious contribution to the early pictorial photography in England.

Cameron's allegorical, religious, and genre pictures are far more problematic than her portraits as for the most part they trespass the natural limits of photography. The titles of some of these fateful pictures are: "The Angel at the Sepulchre," "The Wise and the Foolish Virgins," "The Kiss of Peace," "Venus Chiding Cupido and Removing His Wings," "King Lear Allotting His Kingdom," etc. As models for these pictures Cameron used her husband, Sir Henry Taylor, her painter friend G. F. Watts and his children, her daughters and niece, and her lovely maid Mary Hillier. In 1875 her *Illustrations to Tennyson's Idylls of the King and Other Poems* was published in London



SIR JOHN HERSCHEL. A famous scientist in photography and astronomy, Sir John Herschel first applied the terms "negative" and "positive" to plates and prints; he was also the first to suggest the use of hypo as a fixing agent. He was photographed several times by Mrs. Cameron and this portrait is one of her most striking and interesting

(Coll. of the Royal Phot. Soc., London). These works are undoubtedly influenced by the paintings and drawings of Cameron's friends and pre-Raphaelite artists such as Burne-Jones, Dante Gabriel Rossetti, G. F. Watts, and Holman Hunt. On the other hand there is no doubt that her photographs, in turn, influenced the creations of



ALFRED, LORD TENNYSON. This collodion of the famous English poet by J. M. Cameron is typical of many of her portraits—with rather harsh lighting but strong character portrayal. Mrs. Cameron and the poet were friends and, in fact, she did some photographic illustrations for his *Idylls of the King*. Photo taken about 1868

these painters, a fact which still needs a thorough investigation.

PHOTOGRAPHIC TECHNIC

Cameron used for her out-of-focus pictures two different poorly-defining landscape lenses which were probably constructed for her by Sir John Herschel (Heinrich Kühn in *Camera*, vol. II, 1923, p. 87, "Photographische Rundschau," vol. LXI, 1924, p. 223; *Zur photographischen Technik*, Halle, 1926, p. 43ff.). But it is very likely too that

Cameron, in printing her pictures, put a piece of glass between the paper and the negative in order to get the soft and picturesque effects she desired. At first her "poetical but badly manipulated" photographs were not appreciated because of their technical defects which were for the most part deliberate "fuzziness." At that time sympathetic criticisms were rather rare. "Mrs. Cameron's Portraits are admirable, expressive, vigorous, but dreadfully opposed to photographic conventionalities and properties. They are the more valuable for being so" (*Photographic Notes*, vol. IX, 1864, p. 171). P. H. Emerson estimated Cameron's works very highly, comparing them with pictures by Velasquez and Rembrandt, whereas they were criticized by H. P. Robinson (*Pictorial Effect in Photography*, London, 1879) because of their technical insufficiency.

"She was, in fact, a Whistler in photography," an anonymous lady amateur wrote of her (*The Photographic News*, 1886, p. 2-4). G. F. Watts inscribed one of her pictures, "The Dream," as "Quite divine." About another, "Florence," he said, "I wish I could paint such a picture as this."

In 1864 a series of Cameron's photographs was exhibited for the first time at the 10th Exhibition of the Photographic Society in London. In 1865, 1866, 1867, 1868, and 1873 she was represented again in London exhibitions. She sent her pictures to exhibitions in Edinburgh, Dublin, Berlin, Paris, and Vienna. Retrospective exhibitions containing her works were held in London, Vienna, and Hamburg. Cameron was introduced to America by the periodical *Camera Work* (No. 41, 1913) and through the exhibition of the Albright Art Gallery in Buffalo (1915). According to one source she is said to have exhibited in America during her lifetime.

The majority of Cameron's negatives were destroyed by fire. New prints of her pictures were made by A. L. Coburn and the Autotype Company, London. Besides a translation of Bürger's ballad *Lenore* (London, 1847) and some poems (*Macmillan's Magazine*, 1876, etc.), Cameron wrote an autobiographical fragment, "The Annals of My Glass House," published in *The Photographic Journal*, vol. 67, 1927.

JULIA MARGARET CAMERON

Collections of Cameron's works, for the most part signed and inscribed as original graphic prints, are to be found in:

London—Victoria and Albert Museum,
Royal Photographic Society, 1930:
170 examples

Brockenhurst Station, New Forest,
Hampshire

Freshwater Bay—H. Pullan

Berlin—Dr. Erich Stenger (See *Camera*,
vol. VIII, 1926)

Julia Cameron felt no restrictions on her photographic technic and—as a result—worked in a style of nineteenth century photographic portraiture equalled only by David O. Hill and Robert Adamson.

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JOSEPH JOACHIM. An interesting combination of the somewhat harsh and the esthetic is this Cameron portrait of the German violinist, Joachim. The draped velvet was perhaps a concession to the artistic; the revealing face lighting is typical of the photographer's work

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Plates XVI-XVIII.

The Times. London: January 31, 1939.

CAMP PHOTOGRAPHY FOR CHILDREN

Douglas Haskell

Photographer, Director, Camp Treetops, Lake Placid, N. Y.

Methods of teaching photography to children are given here—especially for the summer camp course, but adaptable to a school or parent-taught home course. The author, who teaches children how to take, develop, and print photographs, tells of the almost infinite patience involved. We learn about the best camera, darkroom construction, and procedure for children. There are some hints, too, on young photographers' activities and projects.

See Also Publicity For Camps, Teaching Photography

CAMP is a vacation; camp photography is not a chore but a hobby. The way to start with it is simply to take pictures. So obvious a statement would not have to be made if there had not been so many dutiful people working up courses and outlines that

approach the subject from a distance and make it seem difficult. Children naturally love images. They are fascinated by the "magic" of making them. Directing children's photography is simply helping the children to implement their fresh vision.

TEACHING THE CHILD PHOTOGRAPHY

The fact is that with the cameras and film now made, any intelligent child above six can at least snap a picture that will satisfy *him*. He needs only to be supplied with a finished print to show him what he has done and his continued interest is assured.

The next step is to learn to print—not develop. Printing is easier; the results are immediate; the lure is unfailing. But the camp counselor had better see to it that the prints "come out." The child's standards of quality are easily met; but what he needs above all else is the confidence that effort put forth will bring a result. Of course, he could not learn without failures; but success at the start and a constant series of successes



Spontaneous shots of children are likely to be difficult to catch, because of the unpredictability of some of the subjects (notice the exuberant pose on the child at the right). Photographs by children of children are often posed and stiff. But this one, taken by an experienced photographer, shows what can be done

Photo, Douglas Haskell

CAMP PHOTOGRAPHY FOR CHILDREN



The child shown in this picture is operating the ordinary box camera, for decades the ideal camera for beginners. The whole camera is built for easy handling. Notice that the shutter can be released with a "natural squeeze," that there is almost no chance for children to inadvertently put a finger over the lens

outbalancing the failures will keep his endeavors in a permanent state of health.

In practical terms, no matter how young the child or how small his own share, his efforts must always result in a finished print that he can show his friends. The younger the child is, the quicker the result has to be made to come. He must not be made to wait.

The only difference, then, between a beginner and a more advanced worker is that with growth the child's own work is gradually substituted for his counselor's, and the quality rises as the child's own perception becomes sharper.

Intelligent children can do a good enough job of developing by the age of about eight. An average child with a couple of camp seasons behind him can develop and print all by himself by the age of about twelve. By thirteen or fourteen, a normal boy or girl can take things into his own hands and manage the enlarger as well as mix the chemicals.

THE CHILD'S CAMERA

So many small children arrive at camp with tiny cameras or with complex precision

instruments that the camp is forced to advise parents on cameras in advance. For children under twelve, the rule should be "the biggest box camera for which he can develop the film." In practice this means the well tested 620 size, with a picture area of $2\frac{1}{4} \times 3\frac{1}{4}$ inches. Even the vest-pocket size is too small and the 35mm size is taboo for a small child. The only reason for not going above the 620 size is that the film becomes too long for the child to hold as he develops in a tray. From about eleven on, the child can handle bigger sizes, such as the 116, $2\frac{1}{2} \times 4\frac{1}{4}$ inch or the 9 x 12cm size. As for the smallest sizes, they are only for advanced workers when dexterity in development is acquired.

At the age of about twelve comes another important break. The youngster can begin to handle bellows cameras with controls over speed, opening, and focus. Before twelve he will usually do much better with a box, really mastering the simple basic elements of photography over which the



Some children prefer a box camera built along more "grown-up" lines, looking more like an expensive miniature than the regular box. While these may be handy and streamlined, children should be cautioned, as the sideways shutter release is likely to cause vibration and the left hand is very apt to block the lens if not held in exactly the right place



Children's projects make good photographic subjects. Hard at work on her weaving, this camper was snapped with synchroflash equipment
Photo, Barbara Morgan

box gives plenty of control, before going on to the more complicated problems.

Among the boxes, the metal ones stand up under rugged camp conditions far better than plastic. Among finders, by far the best are the self-raising eye-level kind; these are the only ones that give the full-sized view direct from nature. Among shutter releases, beware of such things as buttons that push sideward and thus cause maximum blur when the picture is taken!

In one direction, improvement can be made only by the manufacturers. On roll film the flanges are so niggardly and the camera winding mechanisms are almost universally so sloppy in design that a high proportion of the children's pictures are sure to be light-struck and spoiled by end-fog and edge-fog. The counselor can do nothing about it except to assure the child that it was not his fault and at the same time keep the child's enthusiasm high.

CAMP DARKROOMS

In wooden camp construction even an outside wall is very likely to leak light, and it is usually simpler to line the whole room with cheap heavy building paper than to try patching. If the camp has no electricity, a pair of wet batteries—car or radio—can be kept adequately charged by one of the wind-driven generators sold through mail order houses. General Electric makes a 6-volt bulb that screws into an ordinary house socket and can be used in printers; car bulbs in car sockets from the junk man meet all other darkroom needs, when batteries have to be used.



Action and fun—a good combination in a fine camp publicity shot. This has, besides publicity value, interesting pictorial value in the swirling water, the dark foreground, the variety in poses, and the unusual composition
Photo, Douglas Haskell

CAMP PHOTOGRAPHY FOR CHILDREN

If the darkroom is used by young children, it is important that the top of the sink be not more than 30 inches above the floor, to permit easy up-and-down tray developing movement. Long wooden sinks are the most useful kind. Some of the children can develop at the sink; for the others, who use a long workbench, it is helpful to supply large shallow galvanized iron pans, which are partly filled with water and in which the children set their trays. This arrangement

protects both the film and the room if spilling occurs. The pans must be painted, first with an acid paint of the kind that sticks to the galvanizing, then with probus.

Instruments of all sorts must be very accessible. Most of them can be hung on hooks or set in improvised boxes attached to the wall near the place of use; this includes thermometers, tongs, clips, rollers, scissors, and the like. Cheese boxes are one help. Dry chemicals are better kept outside the



This was taken with 2 synchronized flashbulbs. Similar indoor shots are within the scope of advanced children, when they are equipped with the elementary flash units of modern box cameras
Photo, Barbara Morgan



Excursions are fun at camp—and a good time to take pictures. This photo was taken by the author as a camp publicity shot. For more on camp publicity, see article on *Publicity*
Photo, Douglas Haskell

darkroom and mixing done outside, too. Shelves for paper and supplies should be narrow so that one thing does not get hidden behind another. Drawers are a nuisance. A cupboard that can be locked is a help in storing the few delicate expensive instruments that must not be damaged; but morale is better if almost everything is accessible and the counselor relies on the children's common sense.

From time to time it is wise to set aside the regular darkroom trays and graduates and let the children do their measuring with

common tumblers and their processing in cereal bowls or refrigerator butter trays. This teaches the invaluable lesson of improvisation and self reliance.

DARKROOM PROCEDURE

Not more than four young children can work really well at a time; but six or eight campers of the more mature ages will not overburden the darkroom if it is large enough. Two spoiled rolls kept on hand serve for a demonstration for beginners before the lights are turned off. One is used dry, to demonstrate unrolling, the other is wet for practise in "up-and-down" development.

Developer should be of the type that will process Verichrome film in not less than five minutes or more than ten—quicker development can ruin a film before the instructor gets around, and slower development tires the children. The Kodak DK-50 or the D-76 can be nicely adjusted for speed and contrast within these limits.

Panchromatic film should be strictly forbidden to the younger children for simplification in the management

of safelights. But older ones who can work in the dark for short stretches can use panchromatic.

Children's patience is short. By the time the last film is thrown into the hypo they are ready for a run around the house and back. There is rarely a chance for beginners to see their films through the whole washing process unless there is special fast-working equipment. The instructor has to do the washing at first but must make sure the children have mastered this all-important factor before they go home.

CAMP PHOTOGRAPHY FOR CHILDREN

FIELD TRIPS AND PROJECTS

Beginners ought to gang up with friends so that on their first trip they can photograph the easiest, most attractive subject—each other. On that trip the instructor has his hands full explaining how to wind, how to use the finder, how to hold the camera steady, how not to shoot into the light. On this first trip, film must be wasted; the object is to shoot a full roll which the counselor endeavors to have the children develop—if possible—the same day. In this way they can see their results at once. For some time the main problem will be to train the children to get close enough and hold the camera straight and steady. To train them to get close, I have started them early on small resting animals—dogs, goats, or other pets—which don't amount to more than a speck in the picture unless the photographer *has* come close.

In general, there is too much talking done about rules and composition, killing the children's originality and integrity. It is far better to base a trip on some general region, such as the "water front" or on some other hobby, such as bird blinds.

The photography clubs of the older campers branch out into greater specialization. A good deal of the best photography by any young man or young lady—and even by older ones—is done in connection with something else. Thus bird enthusiasts are entranced with building "blinds"; and in flower photography the miniature camera and Kodachrome film come into their own. The young jackdaws in the Science or Na-

ture House can now collect not only rocks, butterflies, and insects—and pictures of them—but also photographs that show the difference between a balsam and a spruce, and even the particulars that make up the difference between a red spruce and a white one.

Incipient reporters put special effort into compiling the record of the big range trips, while camera hunters go with flashlights after deer. Occasionally a snapshot has lost the fisherman his fish; cameras are risked on the baseball diamond, in the horse ring, on the tennis courts, etc.



Favorite photographic occupation of children is taking pictures of their friends. Here are some interesting shots in the making!
Photo, Douglas Haskell



Pictures of children grinning and obviously having a good time are always fun. The informality of the scene helps to carry a natural impression of camp life
Photo, Douglas Haskell

PERSONAL STYLE

In this article, the younger children have been concentrated on, chiefly because of the current misapprehension that real photography begins only with adolescence. On the contrary, real style can be observed by a discerning eye in the photographs just as in the drawings of young children. There is the dramatic young photographer, who is sloppy in technic but always chooses the climactic moment; there is the boy whose pictures run to beautiful texture; there is the girl who has a special way of putting objects in space; there is the exceptional young fellow who likes landscape for its own sake. Adroit questioning reveals that some of these preferences lie deep. The children have no conscious desire to achieve the perceived result.

It is for the purpose of bringing these qualities out for observation that an enlarger is used on the pictures of children too young

to manipulate it themselves. There is no such thing as an artist who is not at heart an exhibitionist; art thrives on recognition. So, when the enlargements go up in the camp dining room, *everyone* is represented by at least one picture. Each print represents the serious young photographer who laid hold of some piece of the world and, by a combination of hard work and magic, made a permanent re-creation of it that is *his*.

CAMPUS PHOTOGRAPHY

John Faber

Staff photographer, E. I. Du Pont de Nemours & Co. Former undergraduate photographer at University of Alabama

The author of this article, a recent graduate of the University of Alabama, was photo editor of three college publications—and knows whereof he speaks. While in college, photography can be a source of great pleasure—and monetary profit, too. The subject matter and the market are ready made. And this article tells how to make the best of both.

See Also Free Lance in College, Publicity Work at College, School and College Yearbook Photography

SUNDAY afternoon is the college student's day for taking pictures and we see him often, hunting out the beauty spots of the campus. He shoots photos of his friends, his house, his professors—anything at all. The campus is always photogenic to the student who wants to take the time and effort to take pictures. It is when one has been out of college for several years that one begins to realize how much those snapshots can mean. Pictures are the best way to reminisce and a fellow can't have too many of them when he looks through his scrap-book years later and recalls the incidents recorded in those prints.

In shooting pictures for his own use the amateur should remember that if he snaps new scenes and new angles his work can be used in the university yearbook. The luck of the amateur usually comes out in close spots and he always seems to be on hand to photograph an important scene that the staff photographer doesn't hear about until

CAMPUS PHOTOGRAPHY

the day after. If he studies his camera and adjusts himself to the close working order of diaphragm openings and shutter speeds he cannot fail to produce good pictures. Now all he has to do is add a little originality and his pictures are fine. When in doubt he should consult the staff photographer of the publication in which he is interested or the News Bureau, photographer, men who are always interested in helping the amateur. I suggest these men especially because they work day after day to promote and record campus activities and can thus give suggestions to the amateur.

He should join the campus camera clubs and exhibit his work in their salons and contests. In such clubs he will meet the better-known campus photographers and get first-hand information from them in regard to the taking of campus photos. The monthly exhibits will create a desire for the amateur to improve his work and at the end of the year a remarkable improvement will be noted. The camera clubs will often slate traveling salon prints and exhibits from other colleges. Often the amateur is a little backward about attending meetings of these clubs because of his inferior knowledge of photography. He should remember that the members of the club all had to learn as he is doing, and will be only too happy to help him with his photo problems. From time to time the club will select certain projects for the entire membership to work on, and he will be able to see the variety of ideas that result on one subject. The amateur should remember always to inject his own personality into his photos, not to copy ideas or composition, and to strive to develop

a recognizable style of his, producing a picture different from anybody else's. He should plan a good system of projecting and filing his negatives so that they are available at a moment's notice. If he does his own developing and printing, he should maintain a clean and regular darkroom procedure.



OUTDOOR PORTRAIT. Of all the pastimes of a student photographer, taking pictures of other students is surely the most time-consuming. And, while taking snaps of classmates, there is no reason why these can't turn into good outdoor portraits with real photographic merit

Photo, John Faber

COVERING THE COLLEGE YEAR

The college photographer has a vast and varied supply of material for his pictures. From September to June his days are packed full of the kind of activity that makes for dramatic pictures. To attempt to list these possibilities is almost impossible—and they vary with each college, of course. But if

THE COMPLETE PHOTOGRAPHER

your imagination has gone stale on you a bit, check with these subjects to see if you have really covered your college year:

1. Students coming off the train
2. Students registering
3. Rush week activities, welcoming receptions, etc.
4. Campus views—old and new buildings
5. C. A. A. and aerial pictures of campus
6. Football games—cheerleaders, crowds, band
7. All sports—basketball, baseball, track, tennis, golf, riding, intramurals
8. Classrooms and labs
9. Campus mascots
10. Professors
11. Celebrities visiting campus
12. Special events—Homecoming Day, Armistice Day, Valentine's, St. Patrick's, Easter, etc.
13. Graduation

Whenever the amateur wants to take pictures of sports events, visiting personalities, etc., I suggest that permission be asked. For example, many athletic coaches do not like cameras clicking around their practice fields. One or two photographers trying to take photos during practice are bound to disrupt the coach's planned routine.

THE CAMPUS IN COLOR

Full color photos have always held a fascination for the amateur as well as the professional photographer. On the campus, color photos are usually used for the yearbook and the University bulletins. Because of the high cost of plates for printing in full color, the color reproductions are held to a minimum. On the yearbook, the division pages and the main title pages are the only ones usually shot in color. All the color



VICTORY BONFIRE. A big event at any college is the victory bonfire—after a football game with the traditional rival. This crackling inferno was built by University of Alabama students. No student photo album is complete without pictures like this
Photo, Michael J. Langan

CAMPUS PHOTOGRAPHY



TWINS. Labelled "Double Trouble," this photograph of twins on an Alabama team is a good feature item for any album or college photo exhibit. A good photograph, well placed on the diagonal
Photo, John Faber

shots I have taken for yearbooks were planned out completely in advance—they have to be. In most cases we take black and white photos first and then copy them for the best combination and story content.

Good shots include cheer leaders in their colorful costumes doing their stunts, campus beauties, the football team on the bench during a game, indoor portraits, view from the top of one of the buildings showing the campus overall with students around the buildings, the weekly dress parade of the R. O. T. C., the honorary cadet colonels in their striking red and white military uniforms carrying flags—all these make beautiful color shots for a yearbook.

I try to shoot color photos on an overcast day when there is a slight shadow on the subject, because perhaps the first principle of color photography is that the contrast in color prints should be in the colors and not in light and shadow as in black and white prints. If I have to shoot photos on a day with lots of sunlight, I use an outdoor white reflector, which must be carefully placed. For outdoor work I use a Kodachrome filter—for indoor work I use blue flash bulbs and no filter. The only need of the University bulletin is a good color shot symbolizing student life for the front cover—usually just a good scene of students going to class, buildings, room designs, etc.

Most of my color work is done on my own hook, just for the sake of experiment and to

see what I can turn out. I have snapped in color a sort of record of my life at college—photos of my friends, university scenes, athletic contests, portraits of my friends on the faculty, etc. Whenever I shoot a photo for the News Bureau or for one of the campus publications, I always snap some shots in color for my own use. One of the most interesting things I have done is to take color portraits of celebrated figures who lecture on our campus and of the big name bands who play on our campus five or six times a year. I usually ask them to pose for a color portrait, and in case they refuse, I use my extension flash unit and shoot them in action. For these indoor portraits I use three photoflash bulbs type 21B. I have one set back of the subject to give backlighting, one flat flash reflected down on the subject from directly above the camera, and one flash in an aplanatic reflector (which acts as spotlight) to one side of the subject to give the highlight effects. I use an open-close



GOING HOME. For night photo work, the student photographer will need synchroflash equipment. This shot, symbolic of vacation time, will bring back memories of pleasant home-comings. DATA: Leica camera, T3mm lens, 1/100 second, Press-40 flash
Photo, John Faber



ELECTION STUNT. During initiations—or even during elections—almost anything can happen. This student is setting a long-distance record for speech-making, an interesting item for a college newspaper or personal album
Photo, John Faber

flash with a diaphragm opening two stops higher than that printed in the Eastman Kodak chart enclosed in every package of Kodachrome. When I have to shoot action I use the extension flash unit attached to my Mendelsohn L-2 speedgun to give extra lighting. On these action shots I use 2B Superflash bulbs.

Almost anything on a college campus makes good color photo material, but I strongly advise that the student photographer plan his color shots in advance and not go out and shoot the first thing that strikes his fancy. He should try to shoot color photo stories with a beginning, middle, and end. Use close-ups and long shots and interesting angles. Then shoot two or three photos of each subject. When the photos are turned in to anyone for consideration, they should be carefully mounted and accompanied with a caption to tie in with each color shot during projection and give them continuity.

Contests are held throughout the year for the amateur photographers, usually conducted by the school paper or annual. Contests sponsored by national publications would be worth all the time and effort expended, as it is in contests like these that the originality of the college amateur is brought to light and recognized. Perhaps the biggest contest held each year in the college field is the one sponsored by *Collegiate Digest*. This contest is divided into five main sections—portraits, scenes, still-life, college life, and action and candid photos. If the photographer keeps this contest in mind, in the spring when it arrives he should have several prints to enter.

AMATEUR'S SALES

Here is a point to remember—when an amateur has a photo that he thinks is good and plans to send it out to a magazine or newspaper for consideration, he should check that shot carefully to be sure that its publication will not harm anyone. I have seen photos sold by amateurs for \$5 that



HOME ECONOMICS CLASS. When making a pictorial record of your campus, do not neglect the academic side! Shots of scientific experiments, projects, methods of work are interesting both to the student and the professor
Photo, Michael J. Langan

undo three months of work on the part of the college News Bureau and cost considerably more to rectify than the \$5. Avoid "stealing" pictures—if the subject you have in mind doesn't want to be photographed, get someone else. There are many photographs that can be taken at college beside the ones that invariably hurt the school itself or some individual or group.

MOTION PICTURES

Many colleges maintain a staff photographer to shoot motion pictures. It is up to the staff man to record all important happenings at the University—to be kept in the archives of the school. For example, at the recent dedication of our library at Alabama, the entire celebration was filmed and all important people who attended were shot. This motion picture cameraman has to photograph all football games and other athletic events. These pictures are later projected during "skull practice" so that the coach may point out the mistakes and the tactics of the opposing team. The various schools and colleges of the University have pictures taken of their students using laboratory equipment, showing living quarters, the campus, etc. These films are spliced together with captions or sound and shown at high schools or conventions so that prospective students may be influenced to attend the University.

For the student photographer the realm of motion picture photography offers unlimited possibilities on the campus. Beside keeping records of boat rides, military



OUTDOOR GIRL. The figure of a pretty girl is guaranteed to improve any picture and this excellent angle shot is sure to be appreciated by the model and her friends. It is a good pictorial with interesting composition and might be what the publicity director or yearbook editor are looking for
Photo, John Faber

parades, football trips, campus activities, initiations, celebrations, etc., the motion picture photographer will find plenty of time to edit and experiment with his motion picture set-up. The school dramatists, cheerleaders, and many others will go out of their way to help him, and incidentally, to be photographed in the movies. By using his ingenuity, carefully planning his shots, and using commercial aids for his movies



PEP MEETING. For college students, "sings" and other excuses for getting together hold very pleasant memories. This candid—showing Alabama students hitting a high note in their corn song—reflects much of the occasion's enjoyment
Photo, Michael J. Langan

three hundred feet taken at each school I visit. I do as little "panning" as possible, relying more on the long shots and close-ups with the camera stationary.

For example, on a recent assignment for *College Humor* I went to Alabama College for Women at Montevalo. To start the story I shot pictures of my assistant packing our equipment into the car and followed it up with a shot along the road. When we got to within two miles of the school I set up the camera, shooting first the road sign giving the mileage and the direction to Montevalo. I next took some shots of our car entering the gate of the school; I then got on top of one of the buildings and had my assistant drive our car out and bring it in through the gate again while I shot it. From the car I panned very slowly, showing an overall view of the school campus. We had timed the entrance of the car through the gate with the changing of classes so that we could catch some students walking on the campus. Many pictures were shot of the historic buildings, first long shots, and then close-ups of girls going in the doors and talking. We closed this film with the car leaving through the same gate with a final overall view of the campus at twilight, closing out with the car going down the highway with a fade. All titles were written down as we took the pictures, and later photographed and spliced into the film.

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . FARRAGUT PARK

The title of our picture is *Farragut Park*. In the middle-distance we see Farragut bravely facing one of those rare moments,—a Washington snow storm! To this writer, however, the picture also speaks eloquently of snow-laden trees and driving snow. One of the main characteristics of driving snow is its veiling effect. As objects recede they appear fainter and fainter until too much snow hides them from view. The main actor on the picture-stage is the group of agitated trees; Farragut plays only a minor part. These trees with their twisted trunks are not regular trees. They are 'city trees', and you can feel that they have been cared for and manicured. This careful pruning gives these trees their unusual appearance. You can feel the power of the wind as you see the branches of the trees give to the limit of their elasticity—bent down, but ready to spring back.

The whole turmoil and anger of a winter storm is expressed in this picture, and that is what makes the picture worthwhile. The composition is good, all except the rather monotonous strip of black hedge that forms the bottom of the print. If it was the photographer's intention to use this strip as a base for the rest of the composition, I would have printed it a little darker. The tonal steps and densities are excellent. In the original print strips of driving snow are distinctly visible against the dark tree trunks. The patterns formed by the various branches of the tree are reminiscent of the best tradition of Chinese painting

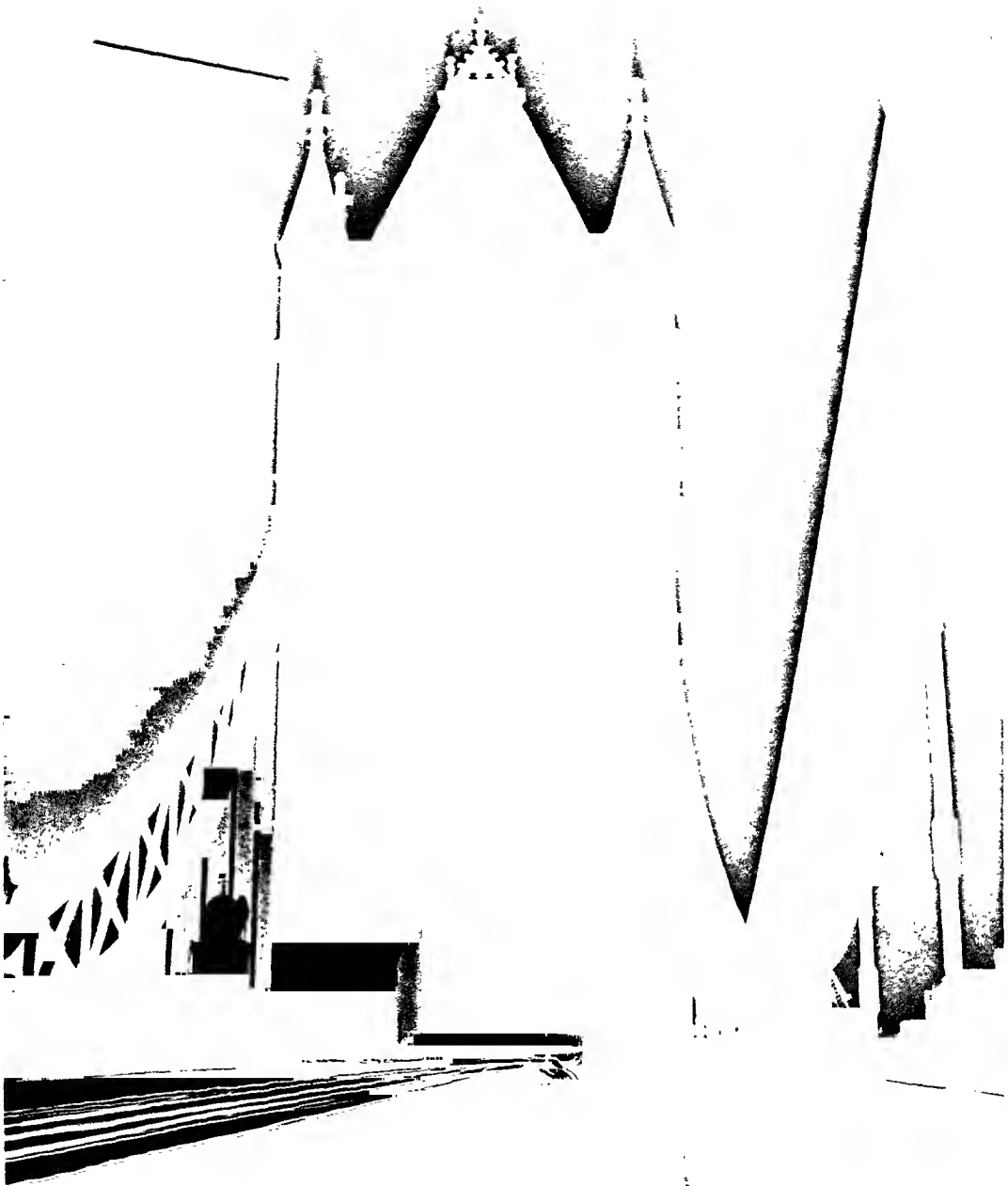
Konrad Cramer



FARRAGUT PARK

MARY ELEANOR BROWNING

Photo shows Farragut Park in Washington, D. C. DATA: $3\frac{1}{4} \times 4\frac{1}{4}$ Graflex, extra fast film, 1 10 second, $f/11$, G filter



LONDON AT NIGHT

MARGARET BOURKE-WHITE

The maker of this interesting moonlight photo says: "Moonlight view of Tower Bridge over the Thames taken from the north end looking south. The light of the moon can be seen behind the main tower. Note the white line in the upper left hand corner of the picture—this shows the passage of a star during exposure. The white lines on the bridge were made by auto lights." See Night Photography, Moonlight Photography



FIRST CONGREGATIONAL CHURCH

CHARLES PHELPS CUSHING

Facing the village green in Litchfield, Connecticut, is this beautifully proportioned New England Church. The photographer chose his time of day and position well—for the sun hits the clapboards and columns at just the right angle, to give them texture. The trees frame the image of the church almost perfectly. Notice the depth of field and extreme detail. DATA: 4 x 5 camera, extra fast pan film, 1/10 second, f/22, K-2 filter



EARLY SPRING

The bare trees, bare sky, and warming sun give much of the flavor of early spring to this photograph—a prize winner at the Gary Works Camera Club, Gary, Indiana. Here is one good example of a picture from the average camera club exhibit. The photo has a wealth of feeling, and there is always something appealing about a solitary and earnest child. DATA: 6 x 6cm. Rolleiflex, medium pan film, 1/50 second, f/11

HENRY BULLER

CAMPUS PHOTOGRAPHY

(Continued from page preceding insert)

Excellent photos can be made with a motion picture camera at a football game. I would like to suggest that the motion picture photographer shoot only overall views of the game, and not bother with close-ups of action, as rapid panning for photos from the sidelines spoils the picture.

SHOOTING FOR CAMPUS PUBLICATIONS

The field of student publications is one that is ever growing in scope. It requires the services of a good campus photographer and contributions from the best of the student amateurs.

Perhaps the foremost of the campus publications at most universities are the *newspaper*, the *yearbook*, and the monthly *magazine*, either humor or literary or a combination of the two. Although these are the more important publications to students attending the institution, there are usually several other little-noted publications, namely the university *bulletin*, issued periodically to alumni, prospective students, and student's parents, the *news letters*, and the *publicity releases*. It is these publications last named that aid in building the enrollment of a university. Therefore they assume a great importance to the publicity department, and thus to the student photographer.

The Yearbook. The yearbook is publication number one to the campus photographer, as it uses by far the greatest number of photos. The yearbook needs clear, sharp photos of student life, caught in a candid mood. Everyone from the lowly freshman to the commercial photographer can take pictures for the yearbook, and with everything from a box camera to an 8 x 10 view

camera. Perhaps the best method for describing the needs of the yearbook is to divide the book into its main divisions, photographically speaking. I will treat these very briefly as the subject of yearbook photography is covered in another article in this publication (See *School and College Yearbook Photography*).

Part 1. The University itself: (a) Scenic shots of buildings, bringing out the architectural beauty of the buildings, with students strolling on the campus. (b) Photos of administration officers, deans of the various schools, important faculty members. (c) Officers and members of campus organizations.

Part 2. Classes: Division pages symbolic of schools or classes they introduce. Among the most important photographs in the book



COLLEGE SPEECH. Student photographers will have a good chance to cover news events, especially when speakers visit the college or when a graduation or class day takes place. Not only are college publications interested in such shots, but also they can be one basis for an interesting personal collection of campus events photos

Photo, John Faber



WIELDING THE BOX CAMERA. For shots of college life, expensive equipment of course is not necessary. The favorite sport of student photographers always will be to take pictures of other students. Here is a decorative photograph in the making
Photo, John Faber

Part 3. Athletics: (a) Commercial photos of each man on each varsity team. (b) Candid shots of out-of-town trips, pep rallies, cheerleaders, crowds at games, shower room shots, action shots, girls' athletics, etc.

Part 4. Fraternities and sororities: (a) Fraternity houses. (b) Commercial photos of actives and pledges of each organization. (c) activities of these groups.

Part 5. Campus beauties, portraits of campus favorites.

Part 6. Campus organizations, a page for each of the many societies, clubs, etc. Mostly handled by commercial photographers.

Part 7. Advertising: In charge of business manager of the yearbook. Photos of students doing something representative of the advertiser.

The Campus Newspaper. And now for the campus newspaper. Like the big city daily, the campus newspaper demands news coverage from its staff photographer. Due to its limited budget, the campus newspaper doesn't use as many pictures as its big city brother, but the pictures it does use have to be good. We have a weekly newspaper at the University of Alabama, which publishes only local news and has no national news service or

photo service. In most of the smaller publications only features can be used. These photos are outlined by the editor so that the photographer knows what the editor expects. It is then up to the photographer to inject his own personality into those photos. I have found assignments from home economics shots to pictures of the campus mascots, but all have had good photo angles on which to work. It is best first to read the story you are to illustrate and then select the best photo angle for the shot. Informality, even when posed, a good expression peak, and collegiate atmosphere are some of the requirements for this type of work. When working on the small college weekly it is best to keep four or five days ahead of your deadline, then if the shot is not what the editor wants there is time to reshoot.

One thing that I have found profitable in work on the college weekly is to maintain a good contact with the nearest local paper. Then when a photo of university events or activities appears in that paper, taken by its staff photographer, the cut can usually be borrowed for use in the next edition of the weekly. If a credit line is used and the whole transaction handled amicably, that arrangement can be used indefinitely, with no expense to the college paper except



DRUG STORE BOOTH. Familiar to any college student is this drug store scene. The same picture could probably be duplicated at any campus in America. DATA: Speed Graphic, synchroflash
Photo, John Faber



COLLEGE FLIER. Combining an aerial view of the Alabama campus with a close-up of one of the University's training planes, this is a good general view photograph and should be a welcome addition to any student's photo collection

Photo, John Faber

postage. In larger schools, of course, where they have their own presses and photo-engraving plants and publish a daily paper, things will probably run smoothly and expense will be a secondary consideration.

The main requirements for good prints to be used in a college are clarity and strong contrast tones, etc., as mentioned in a foregoing section. The collegiate expressions should be the main point of endeavor to the photographer on a college newspaper. But, above all, *catch the collegiate spirit!*

The Campus Magazine. The needs of the campus magazine are similar to that of the newspaper, except for the fact that the magazine uses more cuts, and they are printed on finer paper, thereby requiring better prints so that they will reproduce well in a fine-screen engraving. The editor of the magazine plans with the photographer the illustrations for his stories and the two of them work out together the principle

problems. In our magazine the covers are usually colorful cartoons, run in two or three colors. Occasionally a three-color photo is used for the cover, as in the case of the Homecoming Issue, when a picture of the Homecoming queen (portrait) may be superimposed over a shot of a cheering football crowd.

Most of my work on the magazine covered the shooting of a monthly full-page fashion photo, using two co-eds in a campus setting. The girls walking, talking, looking at a certain point, or in close-ups, show their outfits to the best advantage. The clothing is furnished by a local merchant who gets a credit line on the photo. One sorority girl and one independent girl are used each month. Photo stories are used every month, depending on what the editor wants to publicize or portray. Indoor portraits are used monthly to illustrate thumbnail sketches of outstanding students. For these photos I

THE COMPLETE PHOTOGRAPHER

use the Speed Graphic, shooting my flash to one side of the subject holding the speed-gun in my hand away from the camera.

University Bulletins. The University Bulletin, publicity releases, and news letters require exactly the same type of work, mostly shots of the beautiful buildings, walks, students having fun, students working, the administrative officials, deans, etc. These are used with descriptive literature about the schools, courses, etc. Especially good pictures for this use are shots of students working with the intricate equipment in the school of engineering, the medical school, the department of speech or radio. Students singing on the steps, listening to a classroom lecture (if the room is well lighted), etc.—these make good photos.

The improvements to the university's physical plant are stressed by snapping pictures of the students examining the new air conditioning equipment, the fluorescent lighting units, etc. Pictures are taken of new dormitories, showing the beautiful reception rooms and date parlors, the reading rooms in the new library, and the new field house-auditorium. Other possibilities



A HIT. The student photographer, if he is making a record of campus life, should be sure to include all phases. Girls' athletics is represented by this carefully planned and well taken shot
Photo, John Faber

for the bulletins include air views of the campus, showing the location of the buildings and size of the campus, and shots of fraternity and sorority houses.

Each school and department in the university often has its own bulletin, depicting the work done in that department and worked out by the photographer and the department head. I have found it best to contact each department head and discuss his and my suggestions for his bulletin. The photos are fairly easy to shoot, and can be shot in my spare time without rush.

FOR THE FREE LANCE AND JOURNALISM STUDENT

Lots of fun and pleasure can be had during your college career by taking pictures, but eventually you will graduate and get a job. Some of you will seriously consider going into photography as your life's work. There are, to be sure, great possibilities for you. Many students to whom I have talked seem to put photography with a newspaper or a magazine like *Life* as their ultimate aim, but they do not see that greater possibilities are open to them.

The field of advertising is constantly looking for good photographers; publicity departments need good photographers and manufacturers need them to work on their trade or company journals. The fields of chemistry, engineering, and medicine needs them; the many governmental agencies need them. Magazines need them—opport-



EXUBERANCE. Why not take pictures like this of your college friends—just portraying happiness and good fun? Notice how the extreme low angle helps the general airiness of the photograph
Photo, John Faber

CANDID PHOTOGRAPHY

Phillip Andrews

Photographer, Editor, Publisher

tunities are almost unlimited for the good photographer. With the development of color photography even greater fields are being opened. The student who crashes one of these fields must have three prerequisites. First, experience; second, a means of selling himself to the people for whom he wants to work; and third, a means of obtaining, developing, and maintaining his contacts until after graduation from college.

To obtain experience the student should first decide on which branch of photography it is in which he is interested. He should decide which members of the university faculty or administration could best help him with his work, contact them and by doing work for them free for the first year or so be able to iron out all the amateurish wrinkles. Thereafter he may expect to be paid for his work and should realize that the experience he has gotten is far more valuable than money that he would have been paid under ordinary circumstances.

One way for the undergraduate photographer to get ahead is to experiment with his own technics, trying new ideas until he finds one he likes and masters it. He should not try to do too many things. Until I learned my own personal limitations I was almost dropped from school twice, lost good photos because of rushing, and made enemies of some of my friends because of my rush and preoccupation. Then too, when a man overworks himself he becomes inefficient and that will soon terminate his photo career. Learn what your own limitations are and don't try to overstep them.

Actually much or most of what I have said would apply to most any educational institution that you might attend—and that means high school, technical school, or graduate school, for instance. The point is that school and college years are often more fun than any other years of your life; you also will meet many friends then; and you certainly have a host of new experiences. All of which should and can be recorded by your camera. If you enter the community life and make those friends, see and do those new and exciting things, you cannot help but capture some of the campus flavor in your pictures.

That's about all, I guess. Dig out that camera and go to work!

When the miniature camera came into the photographic field, candid picture taking was given a new lease on life. Today candid photography is important. The author tells here of the beginnings of the candid approach, of famous candid photographers—Erich Salaman, Tany Frissel, Remie Lahse, Alfred Eisenstaedt—of candid photography's uses and abuses.

See Also Miniature Photography

PROBABLY no other term used in photography has so many meanings and ramifications as the word *candid*. The dictionary defines *candid* as an adjective which may be synonymously used for: sincere, ingenuous, frank, impartial, artless, honest, straightforward, transparent, truthful, unbiased, unprejudiced, unreserved, and unsophisticated. If a person is not candid, according to Webster, he may be: adroit, artful, crafty, cunning, deceitful, designing, diplomatic, foxy, insincere, intriguing, knowing, maneuvering, sharp, shrewd, sly, subtle, tricky, or wily.

Most *candid* photographers may be correctly described as frank or impartial, but candid *photographers* will often, and proudly, admit to being deceitful, foxy, intriguing, shrewd, tricky, cunning or almost any other antonym of *candid*.

So *candid* when applied to photography becomes a puzzle and a paradox, and as such it is frequently misused and almost inevitably misunderstood. There can hardly be, for example, any such thing as a candid camera, although in recent years any instrument capable of recording an image on 35mm film and having an eye-level view finder has been flagrantly marketed as candid.

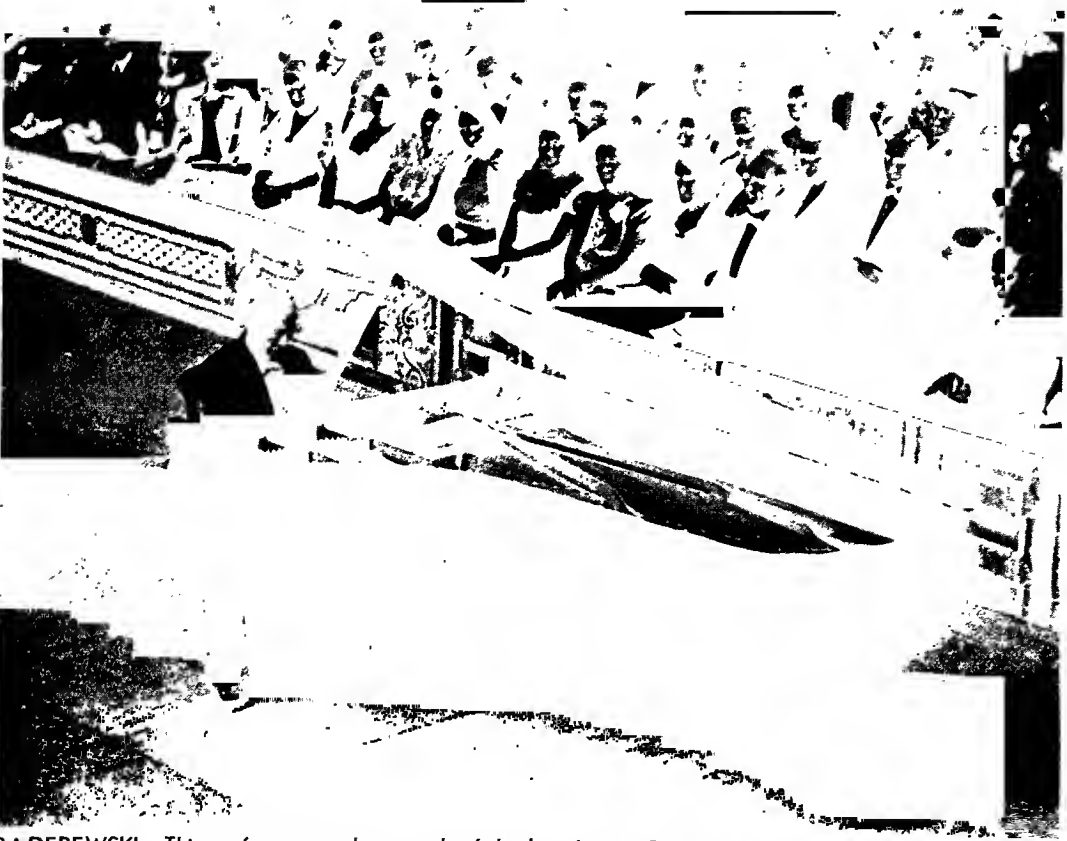
Actually, *candid* describes not the camera but a method of using it. Specifically, if the subject is not aware that a picture is being taken, the ensuing photograph is a candid one. No landscape or still-life, therefore, could provide a candid camera subject. Photographs of babies are nearly always candid for they may be aware of a photographer's presence but not of his purpose.

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Because *candid* is, in even its broadest sense, a form of the word *truth*, the implication is that people who are aware of being photographed are not likely to be themselves. They are inclined to assume attitudes or expressions which are not natural, but acquired. Little wonder then that the candid photographer can be characterized as sharp, shrewd, or sly. He must, if the subject is unwilling, maneuver it into a position which he, the photographer, regards as being typical and expressive, but not self-conscious. He must manage to expose his film or plate at the proper moment without his subject's knowledge, and if he intends to make more than one negative he must continue to be secretive. Flash photography has this single, important disadvantage in candid work.

Because small cameras are most maneuverable, because fast lenses are essential for re-

cording an image in dim light, and because high speed shutters are required for arresting rapid action, cameras possessing these three characteristics have come to be described as *candid*. But mount a Leica or a Contax on a tripod, drown the subject in a blaze of photofloods, ask him to "smile please," and the resulting picture is anything but candid. An 8 x 10 studio camera, however, disguised as a traveling bag or a typewriter might be effectively used to make candid photographs. A camera does not have to be small for candid work, neither does it have to be fitted with a high speed shutter or lens. Candid photographs can be made in brilliant sunlight as well as, or better than, in a badly lighted room. Candid photographs can show a person walking, talking, or just thinking as appropriately as they can record a fast tennis volley or a golf stroke.



PADEREWSKI. This performance photograph of the late Ignace Paderewski was taken in Boston when the eminent pianist made his farewell appearance there. A tele lens made this close-up possible. A most effective and rare shot, with interesting opposition of the lone artist and the crowded audience. DATA: Contax camera, f, 2.8, 180cm lens, 1/30 second, f 2.8
Photo, Arthur Griffin

CANDID PHOTOGRAPHY



EARLY CANDID CAMERAS. These instruments, called "detective cameras," were used during the nineteenth century. The book camera was called "Le Sherlock Holmes." Also shown are: a "photo cravat" or necktie camera, a field glass camera, and several versions of the camera gun
Photo, Eastman Kodak Company

EARLY CANDID PHOTOGRAPHY

There is no definite, unchallengeable record of the first *candid* photograph, but the development of a relatively small and inconspicuous camera is described in an article, "Modern Amateur Photography," by F. C. Beach which appeared in an issue of *Harper's Monthly Magazine* dated 1888.

Beach's article, though it does not mention the word "candid," describes the photographer's concern for the size and bulk of his equipment. Further, it indicates that the cameraman was still self-conscious about his profession. Taking a picture in public was bound to result in a crowd of spectators, for cameras were still something of a rarity despite the fact that there were more than 5,000 practicing photographers in the United States as early as 1870. So that they might practice their craft in the open, photographers readily accepted and quickly put into use the "detective" camera. "These," writes Mr. Beach, "are mostly made in the form of a physician's medicine case, covered with rough leather, or to look like a hand satchel. They hold half a dozen plates, are fitted with convenient devices for quickly setting the shutter, focusing, for changing the plates, and are provided with miniature lenses and reflectors, called finders, which enable the operator to tell when the object to be taken is in the field of view. As these cameras are quite light and portable, they

have become very popular and numerous. They attract no attention, and on that account are particularly useful when photographing in crowded streets or when one is traveling."

Even this increased portability did not seem to satisfy the more surreptitious members of the profession who had already begun to develop miniature cameras capable of taking—though the term had not yet come into use—candid pictures. Cameras were concealed in buttons, hats, watches, opera glasses, even in revolvers—although it is likely that a photographer would have attracted far less attention by aiming what was honestly a camera, rather than a gun, at his intended victim. The smallest and most spectacular of these early miniatures was the button camera which was "suspended from the neck, behind the vest, having the miniature lens projected through a button-hole in the vest and constructed so as to match the other buttons." According to Beach, "The sensitive plate [roll film had not yet been



PHOTO FIELD GLASSES. Sometimes called the Photo Jumelle, this was an ingenious instrument with a camera lens on one side and a view finder on the other. While other detective cameras—the pseudo-gun, for instance—were highly impractical, this was both practical and useful
Photo, Eastman Kodak Company



CAMERA BATTERY. An unknowing subject would be helpless in the face of this battery of candid cameras. Candid photography, as this photo will prove, is possible with almost any kind of camera. Seen here are 35mm miniatures, folding camera, reflex, press camera, and even a matian picture camera
Photo, Hans Kloss

invented] is circular in form, held in a round thin light metal case. After an exposure is made the plate is readily rotated forward until a new section is brought behind the lens. A convenient cord depends behind the vest from the releasing mechanism of the shutter. In taking a picture it is only necessary to walk up to within a few feet of the object, then to quickly pull the string: a slight sound or click at once apprises the operator that the picture is taken. Six negatives may be made on one plate, the size of each being about one and a half inches square. From these, enlarged pictures are easily made."

Prior to this time, candid photography was technically almost impossible. A scientific book published in the 1870's reports the average photographic exposure as being approximately 30 seconds—this was prior to the introduction of the dry plate—and certainly no living subject could be induced to remain perfectly rigid for a full half minute without his being aware that something unusual was taking place.

One of the first candid photographs to attain wide recognition as such was made by Alfred Stieglitz, who at the time of its exhibition in 1902 (10 years after the photograph had been made) was already coming to be known as the "father of American photography." Leader of a group which called themselves the Photo-Secessionists, Stieglitz set the tempo for candid photographs to come with a picture called *Winter on Fifth Avenue*. This print has been recently described by Edward Steichen as "a candid-camera photograph—an impressionistic rendering of man and beast in action in a driving snowstorm. Even today with fancy camera equipment and supersensitive emulsions, many a successful photographer would consider such a picture a very tough assignment. It is still a masterpiece, and forty-nine years ago it was a miracle of achievement."

THE CANDID PHOTOGRAPHY OF DR. SALOMON

Candid photography was an accomplished fact, but a little known word when, in 1930, an editor of *Fortune Magazine* picked up a copy of the *London Tatler* and saw a series of intimate, informal pictures made at William Randolph Hearst's San Simeon ranch. The photographer's name was Dr. Erich Salomon and the pictures included one of himself, in bed. The editors of *Time* and *Fortune* had already done much to revolutionize the technic of news coordination and presentation but they had not as yet been able to do much about news photography which had lapsed into a competent but generally uninteresting formula. Seeing as they later described it "an opportunity of making the American face more interesting, [we] brought Dr. Salomon to the U. S., gave him the initial task of accompanying Premier Laval on his visit to President Hoover in 1931.

"At the insistence of M. Laval photographer Salomon was admitted to the White House. In the Lincoln Study he found conferees Hoover and Laval conversing through an interpreter. Laval, many times a Salomon subject, immediately began gesticulating, talking directly to the President, who could not understand French. Hoover smiled, could not take his eyes off the camera."

CANDID PHOTOGRAPHY

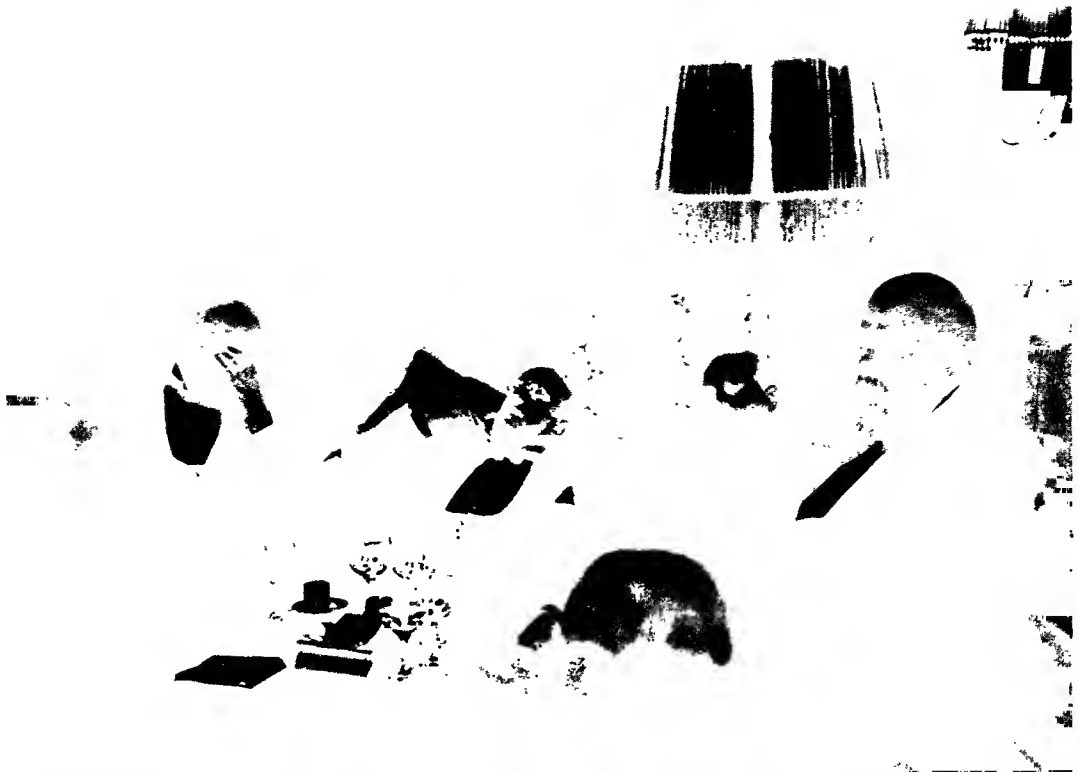
Dr. Salomon's beginning in candid photography was typical of many who preceded and followed him. At the age of 42 he had not even been an amateur photographer. (Professionals are seldom the first to adopt new methods and new equipment, for their success is based on a consistency of technic which, in the interests of their continued livelihood, they dare not disturb). "Dr. Salomon, a bald, heavy-set German with horn rimmed glasses and vast aplomb," *Time* reports, "had settled down as publicity director for the famous German publishing house of Ullsteins. In 1928 he heard of a new camera, so small that it could be held in the palm of the hand, so sensitive that it required no flash bulbs [flashbulbs were introduced in 1930] or other apparatus. The camera was the Leica. Dr. Salomon bought one, learned to operate it. His idea was to take famous people unawares, to show them joking, yawning, eating, playing. He called himself by the name of photo-journalist.

"By virtue of a wide acquaintance among Europe's statesmen, Dr. Salomon gained admission where all ordinary photographers were barred. He got into Geneva conference rooms for such historic glimpses as those of Statesmen Baldwin and MacDonald. When the Kellogg Pact was signed, Dr. Salomon sat suavely snapping pictures from the Polish delegate's seat."

Candid photography as Dr. Salomon conceived of it, is not more than a dozen years old. But in that time it has become more than a photographic technic; it has become a national pastime, and more, it has given new eyes to the picture seeing world. Even as late as the 1920's statesmen were symbols, not people. The public knew little of what these demi-gods thought or said except that which was carefully cut and tailored for general consumption. Likewise their very faces and figures were stereotyped and formalized in the press. The candid camera helped make recognizable human beings out of diplomats.



SUPREME COURT. As far as is known, this is the only published photograph ever taken while the Supreme Court was in action. When this one was made by Dr. Erich Salomon, candid expert, Justice McReynolds was absent. The others are, left to right, Justices Owen Roberts, Pierce Butler, Louis Brandeis, Willis Van Devanter, Chief Justice Charles Evans Hughes, Justices George Sutherland, Harlan F. Stone, and Benjamin Cardozo
Photo from Fortune by Dr. Erich Salomon



HAGUE CONFERENCE, JANUARY, 1930. This is a famous example of candid photography by one of its past masters. Dr. Erich Salomon took this at the end of a night conference of German and French ministers. This, like his shots of the League of Nations, shows famous people off guard, a favorite subject for candid camera photographers
Photo, Dr. Erich Salomon

An early instance is described in *Four Hours A Year*, a book published by *The March of Time*. "I guess, Dr. Salomon," said Britain's late Foreign Secretary, Arthur Henderson, "that you never published that picture."

"The picture had been taken at 2 o'clock one morning in a conference room at the Hague. France's Minister of Labor, Louis Loucheur, was holding an aching head. Premier André Tardieu, exhausted, had flung himself on a couch beside Germany's Foreign Minister, Dr. Julius Curtius. The eyes of old Henri Cheron, the French Finance Minister, were closed. The picture was indeed calculated to shock a British foreign secretary. But had 'Uncle Arthur' kept up with his magazines he would have seen it published months before. It was among the first of the arresting intimate photographs taken by Dr. Salomon and named, by the *London Graphic*, 'candid camera'."

THE CANDID IN JOURNALISM

"What Dr. Salomon and his candid camera started, many a U. S. photographer promised himself to carry on. Not for several years, however, did candid photography take root in the U. S. Then, one day when President Roosevelt was scheduled to sign the Brazilian Trade Agreement, photographer Thomas Dowell McAvoy turned up at the White House. Inspired by Dr. Salomon's work, McAvoy had made careful preparations, had come with film specially sensitized in an ammonia bath. With other cameramen, he was admitted to the President's study. While the others waited until the President should finish his routine letter-signing and pose for them in a better light, Photographer McAvoy quietly clicked his shutter 20 times. Thanks to the sensitized film and inconspicuous camera, he had taken the first complete candid study of a President."

CANDID PHOTOGRAPHY

During the early 1930's candid photography became an increasingly familiar phrase. Most newspaper photographers, however, remained cool toward this photographic newcomer. Few of them were familiar with any but their routine and almost traditional newspaper technic. There were no domestic miniatures of consequence, imported types were too expensive for them to buy with their own money, and results through mishandling and ignorance were too erratic to justify the newspapers' investment in the necessary special equipment.

Surprisingly, many of the candid photographs appearing in print during the first few years of this decade were made not by regular newspaper photographers but by reporters and amateurs. They had no photographic reputations to jeopardize with badly-exposed, poorly-developed negatives and their approach to candid photography was uninhibited by long and exclusive practice with the larger press camera.

One reporter on a Chicago newspaper, who for obvious reasons must remain anonymous, used a disguised Leica to expose the city's gambling dens. The device was not, in a literal sense, candid. It was neither "unprejudiced," "artless," nor "unsophisticated." It was, in fact, "foxy," "sharp," "artful," "crafty," and all the other antonyms for "candid." A lady's handbag was decorated with large glasslike mirrors, about the size of a 2-inch Leitz lens. A hole was cut in the bag allowing the lens to protrude just slightly and in such a manner as to be camouflaged by the mirrors. A cable release was concealed by a silk handkerchief. Together with a woman companion, the reporter visited a number of gambling casinos. The handbag would be placed casually on a table or would dangle typically from the woman's arm. Too engrossed in their game to be suspicious, and even if they had suspected, never thinking that a camera could take recognizable pictures in such dim light, the players were photographed in truly candid fashion. Similar exposés were repeated with other newspapers.

Other such photographic scoops attracted the attention of progressive picture editors and soon every newspaper of consequence had its candid camera specialist

CANDID PHOTOGRAPHY IN ADVERTISING

In 1933, candid photography made its appearance in the pages of *Vogue* and *Vanity Fair*. Condé Nast, publisher of these two magazines, had, like the editors of *Time* and *Fortune*, discovered the potentialities of informal, unposed pictures. Society and fashions had been de-starched; the Vanderbilts, the Whitneys, and the Astors had come out of their cloistered brownstones and the clothes they wore were meant to be lived in. Candid photography provided a new and ex-



CENTRAL PARK. A talented follower of the Erich Solomon technic of candid photography is Lisette Model, French photographer. Her candid shots, while often uncomplimentary to the subject, never make lack of flattery an end in itself. Her candid shots—like this one—are always humorous or symbolic of a time or a people. DATA: Rolleiflex camera, 1/50 second, f 5.6

Photo, Lisette Model

pressive medium for recording the metamorphosis. "Café Society" and "candid camera" as catch phrases made their debuts almost simultaneously.

Again it was an amateur who began to give new interpretations to fashions and fashionable people. Her name was Toni Frissell and she was employed by *Vogue* not as a photographer but as an editorial writer. Perhaps she had seen and been impressed by the

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work of Salomon. At any rate she purchased a miniature camera, presented her ideas to the receptive ears of Art Director Agha and *Vogue's* editors. Shortly, readers of the magazine were surprised and pleased to see clothes worn not by stilted, expressionless models, but by real people doing real and believable things in real and believable clothes. Almost coincidentally, similar events were taking place at *Harper's Bazaar* where Louise Dahl-Wolfe and Art Director Brodovitch were contributing new notes of photographic informality to the world of fashion.

Although neither of these two photographers took candid pictures in the Salomon sense of the word, their general approach

was a direct and logical outgrowth of candid photography. Neither Miss Frissell nor Miss Dahl-Wolfe belongs to the "peep-hole" species of photographer, and seldom do they make their pictures without the full consent and cooperation of their subjects. Their models, professional or otherwise, are simply persuaded to *act natural*. Even this mild laxity, however, was a radical departure from the carefully calculated fashion photographs which preceded theirs.

There were other photographers, of course, who were making more or less casual fashion and advertising photographs at, or before this time. Remie Lohse is generally credited as being the first 35mm camera exponent to

gain national recognition for his candid photographs of society and fashions. In the Middle West, Dudley Lee, a Chicago photographer, was using a miniature camera for many of his advertising assignments, disguising it at times in deference to unenlightened clients, as a larger, more conventional type.

Miniature cameras and the candid photographs they produced were the subject of numerous jokes, arguments, and anecdotes. One of the latter concerned Lee who had been assigned to do a series of photographs showing the manufacture of a product. Lee accompanied the company's advertising man on a tour of the plant, ostensibly to receive instructions as to what should be photographed. The excursion occupied several hours during which time Lee exposed three rolls of 35mm film. Next day the advertising man called Lee and told him that they were ready to go ahead with the picture making. When the photographer arrived with 8 x 10 prints on all the significant phases of



FASHION PHOTOGRAPH. In today's fashion magazines and advertisements, about half of the pictures are posed studio shots and half are informal candid—posed candid, of course. Photographs like this make a beach costume seem wearable. And, while carefully planned to the last detail of the dress folds, the action is natural, the expression spontaneous, and the whole impression is one of a lively candid
Photo, Victor Haveman

CANDID PHOTOGRAPHY



EASTER PARADE. This candid masterpiece is famous. As a social document it is exceptional. See also Mr. Stackpole's article on *Miniature Photography*
Photo, Peter Stackpole

manufacture the advertising man was amazed. He had noticed Lee's actions the day before but had presumed the Leica was some vague kind of photographic instrument for measuring distance or light—only the pictures could have convinced him that it was a camera.

But advertising managers, agencies, and art directors were not long in discovering the sales significance of candid photography. Photographers who had never used anything smaller than an 8 x 10 view camera were supplementing their equipment with Leicas, Contaxes, and Rolleiflexes. New fine grain films, precision enlargers, accurate exposure meters, made photography a far less complicated craft to learn; new credit lines began to appear beneath fresh, casual, intimate photographs designed to sell merchandise.

CANDID PHOTOGRAPHY IN COLOR

As candid photography became customary, even commonplace, and cameramen were beginning to employ odd angles and esoteric subjects in an effort to produce *super-candid* pictures, the introduction of Kodachrome provided new and important photographic dimensions. Like its black and white predecessor, candid color photography was not technically perfect. Here again, however, it was less a matter of any inherent deficiency than of unfamiliarity with the medium. Because Kodachrome was, and still is, much slower than black and white film it was necessary to photograph—even out of doors and in bright sunlight—at relatively large apertures. This cut down on the depth of field, and objects in the distance were rendered an

THE COMPLETE PHOTOGRAPHER

indefinite blur. In black and white photography, an out-of-focus background is tolerable, and often desirable, as it helps to concentrate the center of interest in the foreground. But in color, this fuzziness proved a disturbing and unnatural factor.

Later, Kodachrome, in 35mm and larger sizes was accepted in commercial studios and when handled as carefully as the larger one-shot color cameras, was comparable if not superior in results. The candid camera which had led to greater informality in nearly all phases of photography, was especially influential in color. One-shot cameras, formerly cumbersome and gigantic affairs, were reduced in weight and bulk for easy candid use.

Typical of these new, light color cameras was the Baby Devin and the Lerochrome, now used extensively for candid color work by such photographers as Paul Outerbridge, whose complete familiarity with the color process makes it possible for him to employ a color camera casually. Most color photographers, aware of the cost and time involved in producing a good print or transparency, are inclined to over-arrange and to indulge in excessive stage management. In color and in black and white candid photography, some of the best results have been obtained by the unwary amateur who naively accepts what is given him and just as naively puts it into action without self-conscious purpose.



CHECKERS PLAYERS. This is what is known as a "posed candid." In picture journalism today, where each photograph must tell a specific story and yet where each must be "true to life," the photographer often arranges lights, places the subjects, and then shoots the picture when a natural action or expression occurs. Notice, in this, the spontaneous expressions on all three faces, and yet the careful lighting, deliberate placing of the standing figure. Taken with a Leica
Photo, Charles Peterson

CANDID PHOTOGRAPHY



WORLD SERIES SEQUENCE. During the fifth inning of the famous world series between the Yankees and the Dodgers, these shots were taken with the miniature camera. A photograph which tells a good story is almost always immeasurably improved when in a sequence. Here we see that these Dodger rooters are running the gamut of emotions
International News Photo

SEQUENCE CANDID PHOTOGRAPHY

Perhaps one explanation for the popular tendency to classify all miniature cameras as candid is that a single picture of a person can seldom be considered as a complete and impartial portrait. Because most miniatures can take 36, 40, or even more exposures in fairly rapid succession, they furnish the means of achieving a varied, changing record of a mood or action.

Unquestionably candid photography owes much to the motion pictures in concept and equipment—regular motion picture film is still being marketed for use in 35mm still cameras. An early motion picture camera, the French-made Sept, though inadequate for motion picture use as its film capacity was too limited, had a stop action device enabling one or three exposures—and this was long before Dr. Salomon or anyone else had begun to use the Leica.

Eadweard Muybridge, who comes as close as anyone to being the "father of motion pictures," began his experiments with sequence candid photography as early as 1872. The work was subsidized by Leland Stanford, ex-Governor of California, who had bet \$25,000 that a race horse in action lifted all four feet off the ground. Muybridge rigged up a contrivance which was to eventually consist of 24 cameras placed side by side. When the galloping horse passed in front of each lens he broke a string connected to the shutter and a series of closely related exposures was made. Undoubtedly these pictures were candid in a sense that they arrived at a "fair and impartial" truth (and they proved the Governor to be right), for the Muybridge pictures of horses, men, women—even elephants—changed habits of seeing and even painting. The convincingly real western paintings of Remington were attributed to Muybridge's revelations.

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CANDID MOTION PICTURES

Actors in front of a movie camera are generally conscious of being photographed. But it is certain that some early motion picture photographers used their cameras in candid fashion. There are many single frames from D. W. Griffith movies which are similar in many respects to some of the first candid photographs.

In recent years, however, the development of motion pictures has been toward self-consciousness rather than away from it. This tendency was intensified by the introduction of sound, which contributed additional bulky apparatus and caused the editors of *Time* to comment when they were outlining the editorial program of *The March of Time* that "there must be some other way of portraying a U. S. statesman besides backing him up

against a wall and letting him stand there jawing at you for 30 seconds."

What they proposed to do about making motion pictures more candid was outlined in a *Time* prospectus: "While *The March of Time* was still young, the editors stumbled into a big discovery . . . cameramen had gone to the unimportant town of York, Pa., to photograph Fred Perkins, the hard working battery-maker who went to jail in challenge to N. R. A. Almost before they knew it, they had him acting out his own role, in his own person. When the film was developed Pa Perkins washing his hands was real. Ma Perkins preparing supper, the Perkins kids, the simple men who worked for Pa Perkins in his battery shed—they were all real. Here *The March of Time* discovered that real people can be photographed doing naturally that which it is their nature to do.



HALLOWEEN. When the candid camera first came into general use, it was the vogue to take off-guard, uncomplimentary, and often cynical pictures. In recent years, however, there has been a certain toning down. Such pictures as this one prove that fleeting expressions need not be unpleasant or uncomplimentary in the candid photograph
Photo, Arthur Griffin

CANDID PHOTOGRAPHY



THE DOCUMENTARY. As opposed to the minutely directed Hollywood productions, the documentary is free to be somewhat candid. Jaris Ivens, a movie director for the government's Farm Security Administration, is shown explaining a camera angle to Flayd Crasby, A.S.C. They will shoot Mrs. Hazel Parkinson as she scrubs her own wash in her own shed. Her actions will be her own and the shot will be a "posed candid"

"From then on *The March of Time* sought out real people. It photographed them where they lived and worked, as they labored and played, as they schemed and fought, and prayed for rain. It undertook to stage-manage senators and cabinet members in their houses and offices, and get them to act again some newsworthy episode for the benefit of a public to whom they were hitherto only vague characters. Camera crews went into offices, mines, fields, churches, bars. The result is a new gallery of American faces, as the reels unroll. Farmer faces, mining faces, faces of rugged individualists, Harlem faces, hopeful tired faces, smart night-club faces—faces from Tennessee, Texas, New England, and the Pacific Coast—the faces of the U. S."

Many of these were made in a truly candid manner

with cameras concealed in doorways and automobiles, others were filmed with the subject's cooperation, but all were—in comparison to the formal, self-conscious films which preceded them—candid.

CANDID PHOTOGRAPHY TODAY

In the years that have elapsed since Dr. Salomon's pictures first appeared in the *London Graphic*, candid photography has gradually been made more "perfect"—and consequently has become somewhat self-conscious. The uncoached, uninhibited actions that distinguished the earlier candid photographs from the conventional journalistic and commercial work, was not

enough to satisfy some publishers and some photographers. In the early months of *Time* and *Fortune's* healthy offspring, *Life*, staff photographers armed with a Leica or Contax



PARTY SHOT. At a party given by Edgar Bergen in Hollywood, this flash photograph was taken, and used in a "LIFE Goes To a Party" story. The invention of flash equipment, and especially of synchroflash, has expanded the candid field to such an extent that now there are almost no obstacles facing the candid photographer. This shot of a bartender is excellent. DATA: 35mm camera, f 2.8 Biagon lens, 1/250 second, f 7, one Press 40 flash

Photo, Peter Stackpole

THE COMPLETE PHOTOGRAPHER

would mingle inconspicuously with the crowds at a Mad Arts Ball or a Nebraska Corn Husking Bee. But "*Life Goes To A Party*" became a press agent's dream and the magazine received more invitations than it could possibly accept. Eventually a *Life* photographer at a party was less a photo-reporter than a visiting celebrity. Synchronized flashguns heralded his presence and people would stop acting like themselves to become their own or the photographers' version of a Mad Artist or a typical Nebraska Cornhusker.

Today the candid photograph is hard to find in *Life* or *Look*, or in any other of our numerous picture magazines—but the British who know a good thing when they finally find it have continued to present in such of their magazines as *Picture Post*, candid pictures of people unheedingly going about the serious business of defending their homes and their way of living. Perhaps it is

because no flashbulb has yet succeeded in penetrating the omnipresent London fog—but whatever the reason, the results have a nostalgic significance for the original candid cameramen who operated on such simple logic that if action was so fast that the eye could not follow it, then that is the way it should be photographed, that a smoky, underlighted speakeasy would not have the same poignant quality if exposed to the unsympathetic glare of flashbulb.

Candid photography as such is on the wane, but it has left its mark. Cops, dancers, movie stars, politicians—the entire composite face and figure of America has been photographed from every conceivable angle. What the public wants to see, or at least what it is being shown, is not an underexposed, overdeveloped picture of an executive scurrying down a dimly-lighted hallway but a stage-managed news photo, which, though informal, is as brilliantly, beautifully lighted



NIGHT CLUB. When fast film and lenses came into use, many fields were opened to the candid photographer. Rudolf H. Haffmann was one of the first to experiment with action shots of after-dark entertainments. From such beginnings, candid photography at theatres and night clubs has become an important field—and a profession
Photo, Rudolf H. Haffmann



THE SUPER CANDID. A candid photograph of a candid photographer about to snap a candid photographing policeman! This sort of thing can go too far, of course, and it is good to see that the man in the background has refrained from making a candid shot of the whole thing
Photo, Hans Kloss

as a studio portrait. What the public gets now is not a rear-three-quarter view of an athlete in his dressing room, but an ultra-high-speed document of a record-breaking pole vault, arrested in mid-air by Dr. Harold Edgerton's remarkable speedlamp. Still photography is taking the course that has made Hollywood's film productions so technically perfect but—very often—so esthetically bad. By freezing the fast-moving legs of Jesse Owens, the runner ceases to move at all; by stopping Billy Conn's lightning left hand, the fighter becomes static as a statue. The miniature camera has been over-burdened by cumbersome accessories in an effort to emulate the mechanical proficiency of larger cameras—and in so doing has sacrificed its candid characteristics. Miniature camera photography is, of course, not synonymous with candid photography. But neither is the miniature capable of imitating the large camera. Both have their fields—their advantages and disadvantages. And these should be recognized.

The work of Muybridge, Salomon, and perhaps even Stieglitz—might not be technically acceptable to picture magazines today but the candid photography they produced has undoubtedly helped to liberate photography of all kinds from the self-consciousness and formality which has typified this branch of art during the more than hundred years of its existence.

CARBON PROCESS

B. Chambers, F. R. P. S.

Autotype Co., Ltd., London

The carbon process is essentially a contact process, where a bichromated and pigmented gelatin is the printing base. It should interest photographic workers who are interested in a variety of tone effects—as the range of available pigment and support papers is very large. A step-by-step description of the process is given here.

All photographs by Bernard Alfieri, Jr. unless otherwise credited

See also Carbro Process, Control in Photography

THE CARBON print, though requiring more time to produce than other prints, has great advantages and the superb results well repay the extra time taken. It is, briefly, a photographic printing process wherein a bichromated and pigmented gelatin is made insoluble—when printed under a negative—in proportion to the amount of light which strikes it. When the soluble pigment is washed out by warm water, the image is revealed. It is called "the carbon process" because the pigment is often made of carbon.

Probably the greatest appeal of the process to the average worker is the variety of results obtainable. While in most of the other printing processes only one color, with perhaps slight variations of tone, is possible, the carbon worker has enormous scope on account of the large number of pigment papers of various colors and the equally large selection of support papers.

A seascape or woodland scene, printed in one of the several greens available, will often reveal qualities unsuspected in the negative, while the mellow soft tones of ancient woodwork or masonry may be beautifully rendered in brown or black.

In quality, carbon still holds a front rank position. The image is composed of pure

pigment in gelatin, which gives a brilliance and richness of remarkable quality. The results are absolutely permanent, and extremes of temperature or climate have no detrimental effect.

Carbon printing is not difficult, and given a negative of the requisite quality—a most important point—and care in manipulation at the various stages, no undue difficulty should be experienced.

ORIGINS OF THE PROCESS

The basis of all the processes to which reference will be made is the action of light upon organic matter in the presence of the alkaline bichromates. Mungo Ponton first observed this action when exposing to light paper which had been immersed in a solution of bichromate of potash: Becquerel showed that sized paper acted much more rapidly under such action than unsized paper. And so the association of gelatin or gum, or their analogues, with the bichromates was found in such experiments.

Poitevin found that if a pigment were mixed with the compound of gelatin and bichromate, those portions upon which the light acted were rendered wholly or partly insoluble. On putting his exposed pigmented paper in warm water, however, he found the pigmented compound floated away from the paper altogether. But he also found that if he spread his pigmented gelatin very thinly and exposed it to light under a negative with pure black and white lines, he was then able to dissolve away only those portions upon which the light had not acted. And he actually so produced the first photograph in pigment.

IMPROVEMENTS

The late Sir Joseph Wilson Swan introduced the first practical method of pigment printing in 1864. He coated glass with pigmented gelatin, but first coated it with collodion. When the whole was dry it was stripped from the glass. Thus was made the first autotype pigment paper.

Later, he did away with the collodion and glass, and simply spread his pigmented gelatin on paper. This was exposed to the action of light under a negative. The surface was then coated with India rubber solution

and forced into contact with a piece of paper similarly coated. The adherent sheets were then placed in warm water which softened the gelatin in contact with the paper upon which it was first spread, enabling the gelatin to be skinned off. The picture was washed up from the back, rinsed in cold water, allowed to dry, and there was the photograph complete, resting on the India rubber paper. But it was reversed. To obviate this, paper was prepared with gelatin, rendered practically insoluble by means of alum. When this was placed in warm water the gelatin became softened. The photograph on the India rubber paper was then put into contact with this gelatin paper under water and the two surfaces brought together. When dry, the India rubber paper was removed, revealing the print in its proper position, attached to the gelatin paper.

In 1868, J. R. Johnson found that in order to fix a pigment print upon a permanent or temporary support no cement was necessary, provided that the support was impervious to air and water; that if one simply lay the wet tissue upon such a support, removing the air and excess of water from between the surfaces, the insoluble or partially insoluble surface of the tissue adhered to it. The tissue, thus mounted on an impermeable support, was placed in warm water which, softening the gelatin at the back, enabled the paper to be skinned off and the picture developed.

If glass is used as the support, the picture is complete as a transparency, or as a picture to be viewed by reflected light when backed with paper. If the support is not transparent, the picture is inverted if ordinary negatives have been employed.

In 1874 J. R. Sawyer introduced his *Flexible Temporary Support*, which, by permitting the development of the picture on a soft couch or film of an insoluble colloid body, secured perfect adhesion.

The temporary support consists of a tough and hard paper specially made for the purpose, and coated very evenly by machinery with a solution of gelatin which, when dry, is perfectly insoluble. This is again coated with an alkaline solution of lac, and the surface is next treated with a waxing

CARBON PROCESS

compound which enables the picture to be easily stripped from the support on the application of the transfer paper. The advantages of this support are numerous. It enables the picture to be viewed perfectly during the process of development; the yielding nature of the surface holds without blurring the delicate detail of the image. The pieces of support can be used over and over again almost indefinitely.

Such were the various stages by which the autotype carbon method of producing photographs reached its present development.

The process has passed through the early stages of difficulty and uncertainty to establish success, owing to a more complete understanding of principles, to simplification of procedure and to great improvements in the manufacture of materials. Unlike photographs produced in silver compounds, the carbon print is as durable as the pigment employed in its production. If this is permanent, so is the print, for it owes its color entirely to this inert pigment in its unchanged condition.

The material employed for prints in permanent pigments is known as autotype pigment paper or carbon tissue. One of the very great advantages that this process possesses, besides permanency of results, is the variety of colors in which the pigment papers are obtainable, there being, in fact, a range of about 30 different colors.

SINGLE AND DOUBLE TRANSFER

There are two methods of producing carbon prints: single transfer and double transfer. If prints are made from ordinary glass negatives the image in the finished print is reversed by the single-transfer method. To correct this reversal the double-transfer method is employed. That is, the image is developed upon a piece of temporary-support paper and then transferred to a final-support paper, which will bring the



SENSITIZING THE PIGMENT PAPER. As explained in the text, this is done with a bichromate bath—but in the illustration a spirit sensitizer is being used for speed. It should be applied with a piece of soft flannel, with firm and even strokes

image the right way round. Most films may be printed by the single-transfer method by reversing the film in the printing frame.

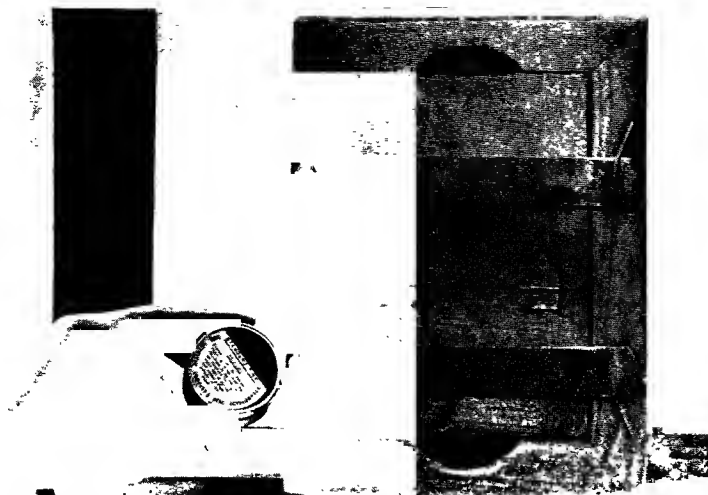
When making glass negatives especially for carbon printing, the usual method is to reverse the plate in the plateholder by placing the glass side nearest to the lens and, of course, making the necessary adjustment to the focusing screen. This will give a correctly placed image when printed by the single-transfer method.

SENSITIZING PROCEDURE

The first step necessary in the production of a carbon print is the sensitizing of the pigment paper. Some pure bichromate of potash is dissolved in hot water. One ounce of bichromate to each pint of hot water will give, approximately, a 5% bath—a convenient standard for dilution as required. A 4% bath is about correct for normally dense negatives, but a weaker bath may be advantageously employed for weak negatives.

It must be remembered that the strength of the sensitizing bath affects the printing speed of the paper. For instance, pigment paper sensitized in a 1% solution requires about three times more exposure than a piece treated in a 4% solution and printed from the same negative.

A piece of pigment paper slightly larger than the negative to be printed is placed in



THE PRINTING FRAME. When dry, the carbon tissue is placed behind a negative in a printing frame. Before exposure—by indirect sunlight—the time is calculated by means of the actinometer, as shown

the above bath, which must be cold. The paper should be thoroughly immersed, any air bells should be removed, and the edges of the pigment paper should not be allowed to come above the surface of the solution. Two minutes' immersion will usually be sufficient to allow the pigment paper to absorb enough solution. It will then lie quite limp and flat in the bath.

The saturated pigment paper is then removed and laid face downwards on a sheet of glass and any superfluous solution removed with a flat squeegee. It is then stripped off the glass and hung up by one corner to dry in complete darkness. The sensitizing should preferably be done in artificial light, but if done in daylight great care must be exercised to see that it is very subdued.

When dry the pigment paper is highly susceptible to the action of daylight, and unless kept in special storage boxes it will not keep in good working condition for more than a few days. For the quick sensitizing and drying of pigment paper a spirit sensitizer is available, but the

method described above is preferable.

PRINTING PROCEDURE

Prior to printing, the negative must be provided with what is known as a safe edge—an opaque margin all the way round. This can best be done by cutting a paper mask. The object of this safe edge is to give a soluble margin all round the picture. The negative is then placed in the printing frame in the ordinary way, and a piece of the sensitized pigment paper, slightly larger than the masked image, is placed in contact

with it. It should be pointed out that the ideal negative for carbon printing should be decidedly “denser” and “richer” than those employed for most other printing methods.

Printing is carried out in daylight but not in direct sunlight. And as no visible image is formed during the printing stage the exposure is determined by means of an actinometer (see article on *Exposure Meters*). These may be obtained in several forms, but the principle of working is the same in each case. In the simpler form, a strip of printing-out



TISSUE AND TRANSFER. After printing, the exposed tissue and a piece of transfer paper are soaked in cold water and then placed together as shown. After squeegeeing they are left between blotters for some 20 minutes

CARBON PROCESS

paper is placed under a numbered density scale in the meter and exposed. The correct exposure is determined when the numbers visible on the strip are compared with an exposure chart. A photoelectric meter is also used to determine exposure.

When the correct exposure for a negative has been found, it is as well to register details for future use and as a guide for other negatives of similar density. There is no necessity of opening the frame during printing. As a rough guide it may be mentioned that pigment paper sensitized in a 4% bath is about three times as rapid as ordinary printing-out paper.

Up to this point the method of procedure will be the same whatever the nature of the support upon which the picture finally rests. This may be of paper, canvas, wood, ivory, porcelain, glass, metal, etc. The pigment paper after having been exposed to the action of light under the negative has the latent image formed in the pigmented gelatin. The gelatin has been rendered insoluble in proportion to the amount of light striking it through the negative. The insoluble image is on or in the upper portions of the pigment coating, the soluble portions being the lower parts or those in contact with the paper on which the coating was originally spread. Development, therefore, must take place from the back, the face of the pigment paper being mounted upon some support to retain it intact during the process of development.

When printing has been judged to be complete, the pigment paper is removed from the frame and placed in a tray of cold water until the tendency to curl has nearly vanished. Assuming we are proceeding by the single-transfer method, we place it in contact with the prepared side of a piece of single-transfer support which has also been previously thoroughly soaked in cold water. The two are then laid face to face on a piece of plate glass, or other smooth support, and thoroughly squeezed together. They are



STRIPPING THE TISSUE. When the pigment begins to ooze out from around the edges, the tissue backing is gently pulled off

then placed between blotting boards and left for about 20 minutes, after which development is carried out by day or artificial light.

DEVELOPMENT

Development is begun by placing the mounted pigment and transfer papers in water at about 100° to 105° F. In a short time, only a few seconds, the soluble parts of the pigment paper will begin to ooze out around the edges. This is the signal for gently stripping the two apart, taking care to keep them under the surface of the water while doing so. The pigment paper is now thrown away. Development of the image, which has been transferred to the transfer paper, is continued by gentle splashing with the warm water. When all superfluous pigment has been dissolved away, the image is fully revealed.

A certain amount of control is possible during development, as by pouring a stream of slightly hotter water onto a given part a highlight can be cleaned up or shadow detail be more clearly revealed. When development is complete, the prints should be placed in clean cold water and then transferred to a 5% solution of potash alum until the yellow stain left in the paper by the bichromate has disappeared. After a final rinse in several changes of clean water the print is hung up to dry. The print should be dried evenly, as in any photographic process. And, too, the carbon should be very carefully framed.

DOUBLE TRANSFER

Development in double-transfer printing takes place upon a temporary support, the object being to bring the resulting picture

into the correct position by means of a subsequent transfer. This temporary support may be of a rigid substance such as matte opal glass, or flexible paper. Before use it is treated with a waxing solution, which allows



FOUR STAGES OF CARBON PRINTING. After immersion in hot water, the soluble parts of the pigment paper will begin to ooze out around the edges (upper left) and is ready for stripping (upper right). The image then begins to appear (lower left) as the superfluous pigment dissolves away in the warm water. When development is complete (lower right), the print is ready for a cold water immersion and a final rinsing in an alum solution
Photos, B. Chambers

CARBRO PROCESS

the image to leave the support at the appointed time.

The general instructions given in the preceding pages on printing and development are applicable, but care must be taken not to overprint, as there is less latitude when developing upon a temporary support than in single-transfer.

The temporary support, when put in the mounting water, will curl, only one side being pervious to water, and must be allowed to remain until it becomes flat before the pigment paper is mounted onto it.

After development the prints should be treated in the same manner as single transfer—rinsed in cold water, put into the alum bath, again rinsed, and hung up to dry.

A piece of final support (larger than the print but somewhat smaller than the temporary support on which it has been developed) should be soaked in cold water, placed in water of about 90° F. for about 2 minutes, and returned to the cold water.

The dry print on its temporary support is now put into the cold water till limp, and then placed face uppermost upon a smooth flat surface. The piece of softened final support is placed upon it and the two lightly squeezed together. The transfer coating and the developed print, which is an image in relief, become one film when dry because the softened gelatin has moulded itself into the inequalities of the picture.

The adhering papers are then hung up, and when thoroughly dry they are stripped apart. The image is found intact on the final support.

This process, while somewhat complicated and a bit foreign to other photographic processes and technics, has advantages all of its own, not the least of which is the advantage of variety. Through variations in paper tones and colors, many effects may be obtained. But the tone or color should be carefully chosen, as in the toning process. Well done, however, the carbon process can add a great deal to any picture.



DEVELOPMENT. The pigmented print is placed in warm water and agitation takes place until the surplus pigment has been washed away

CARBRO PROCESS

B. Chambers, F. R. P. S.

Autotype Co., Ltd., London

The carbro process is derived from the carbon process—except that here the bromide print or enlargement is used. Practical instructions are given by an expert, and present this interesting transfer printing technic in an understandable way.

All photographs by Bernard Alfieri, Jr

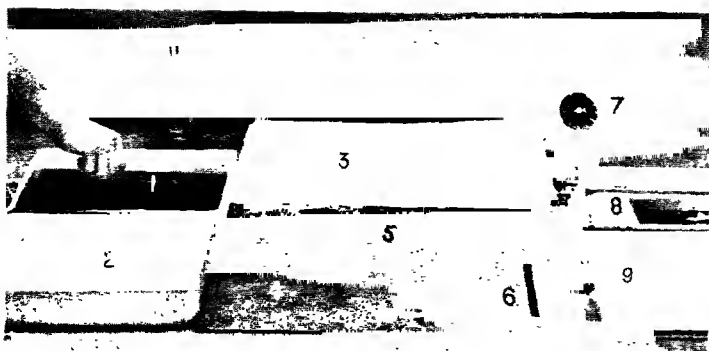
*See Also Carbon Process, Color Printing—
Carbro, Control in Photography*

CARBRO may be aptly termed the offspring of carbon, for it is an adaptation of the latter process, and its origin is of a much later date.

A carbro print is actually a carbon, but, whereas in carbon it is the light passing through a negative which renders sensitized pigment paper insoluble in varying degrees, in carbro this action takes place by a chemical reaction between pigment paper and a bromide print.

ADVANTAGES OF CARBRO

All the advantages possessed by carbon cannot be claimed for carbro, but, on the other hand, the latter process has advantages of its own, which appeal to the worker lacking facilities for daylight printing, or not inclined to enlarged negatives. Furthermore, after the production of the necessary bro-



CARBRO BENCH LAYOUT. (1) First bath. (2) Second bath. (3) Wax paper. (4) Glass. (5) Knife. (6) Squeegee. (7) Clock. (8) Cold water tray. (9) Warm water tray. As shown here, the bromide print is in the cold water, the tissue is in the first bath

mide print, all further operations can be carried out in full day or artificial light.

The full range of pigment papers and single-transfer papers, as described in *The Carbon Process*, are available for carbro.

Anyone with facilities for making bromide prints, and a supply of hot and cold water, can attempt carbro printing. In addition to a bromide print and the essential chemicals, a supply of pigment paper, single-transfer papers, and a flat squeegee are necessary.

The two trays which are to hold the solution should preferably be of porcelain, but enamel ones may be used provided they are sound. Two additional trays will be required for soaking and washing purposes, and these, together with a piece of plate glass, a few blotting boards, and some waxed paper, complete the outfit.

What actually takes place in the production of a carbro print is that the chemicals absorbed by the pigment paper bleach the silver image of the bromide print and at the same time tan, or render insoluble, a portion of the gelatin of the pigment paper exactly corresponding to the image. This insoluble gelatin image adheres to the transfer paper but, during the process of development, all the soluble gelatin is removed by the warm water, leaving an image in relief, made up of varying thicknesses of insoluble pigmented gelatin.

It is this relief image which gives such superb depth to the shadows and other unique qualities which are characteristic of carbro prints.

Just as the gradation and quality of a print made by the aid of light are dependent on the quality of the negative, so is the excellence of a carbro governed by the quality of the bromide print. Any of the standard makes of bromide paper may be used, those grades known as platino-matte or ordinary being the most suitable. Glossy papers are liable to give trouble when squeegeeing the pigment paper to them.

Rough grades tend to retain air in the crevices, and to prevent good contact with the pigment paper, while chlorobromide or gaslight paper is quite unsuitable. It has been found that bromide papers which have been supercoated in order to prevent stress marking frequently give carbros with granular highlights or from which the lights completely develop away. This trouble may be overcome by making prints somewhat stronger than normal, but it is better to avoid supercoated papers.

PROCEDURE

As the quality of the bromide print is of the utmost importance, care must be exercised to ensure accurate exposure and full development. It is advisable to make the bromide print with a white margin all around—its purpose being to give a margin of soluble gelatine without which the carbro may frill during development. Whether the bromide is masked or not, it is important for the pigment paper to overlap the image.

First of all, the bromide print and a piece of transfer paper are put into a tray of cold water to soak. Should any difficulty be experienced in determining the coated side of the latter, place the paper between the teeth and the coated side will adhere slightly. It is advisable to make a pencil mark on the uncoated side so that no doubt will arise later. For the thinner varieties of transfer papers, only a few minutes' soaking is necessary, but the thicker ones require longer. But any reasonable length of time can have no injurious effect. Next the two working baths

are prepared, the composition of which are as follows:

Concentrated Stock Solution No. 1

Potassium bichromate	1 oz.
Potassium ferricyanide	1 oz.
Potassium bromide	1 oz.
Water	20 ozs.

Concentrated Stock Solution No. 2

Glacial acetic acid	1 oz.
Hydrochloric acid (pure)	1 oz.
Formaldehyde (40%)	22 ozs.
Water	1½ ozs.

From these concentrated solutions the working baths are made up as follows:

No. 1 Stock Solution	6 ozs.
Water	18 ozs.
No. 2 Stock Solution	1 oz.
Water	32 ozs.

If preferred, these solutions and other necessary materials can be obtained in convenient form from the Autotype Co., Ltd., of London or George Murphy, Inc., 57 East 9th St., New York. The first bath can be used for a considerable time, and so should be bottled for future use, but the second bath must be renewed frequently and thrown away after use. A 32-oz. bath of the latter would be enough for ten prints of 10 x 12 inches. The temperature of the working baths should be about 60° to 65° F., as it is difficult to obtain good results should these be either too hot or too cold.

An ample quantity of the two working baths is now poured out in two separate trays and a piece of pigment paper immersed in No. 1 bath. At first it will show a tendency to curl, and care must be taken to keep it under the surface of the solution. Any air-bells that may have formed, either on the back or front, must be gently wiped off. After 3 minutes the pigment paper is withdrawn, and after being allowed to drain for a few seconds is then placed in No. 2 bath, care being taken to immerse it thoroughly without delay.

The time of immersion in No. 2 bath will vary according to the result desired, and a considerable amount of control is possible here, a longer immersion than normal tending to softness, and a short immersion to increased contrast and brilliance.

For a normal result, about 20 seconds will be sufficient. Different makes of paper vary

somewhat in their requirements, but the principle is the same whatever make is employed. Only experience can determine this, but periods of from 10 to nearly 60 seconds may be employed if occasion demands. In districts where the water supply is very soft, the immersion time in No. 2 bath becomes very short, and under such conditions the No. 2 solution may be diluted to 1 part of concentrated to, say, 45 parts of water, when the time of immersion required will be nearer 20 seconds.

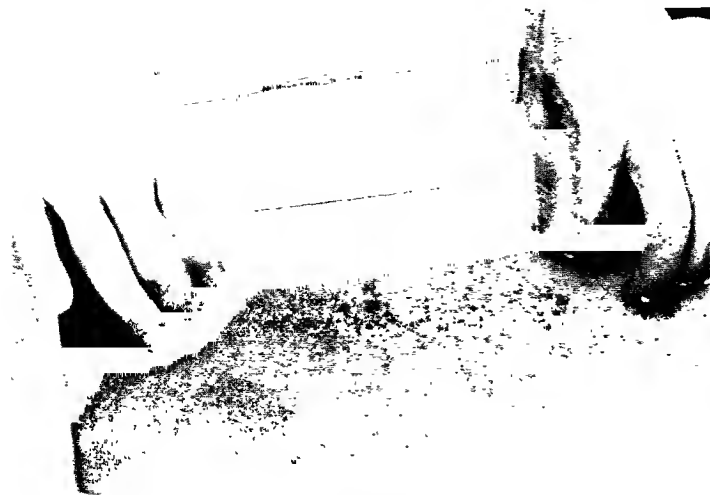
While the pigment paper is in the No. 1 bath, the bromide print is removed from the soaking water, placed face upwards on a level sheet of glass and the squeegee passed lightly over it so that it adheres to the glass. This will obviate any tendency to slip, and a little clean water is again poured on it. After three minutes the pigment paper is withdrawn from the No. 1 bath, drained for a few seconds, and is then placed in No. 2 bath.

THE TRANSFER

At the end of the number of seconds decided upon it is taken out and placed without delay upon the bromide print in such a manner that the edge is square at the left-hand margin of the bromide. These two edges are then pressed down firmly with the fingers and the rest of the pigment paper quickly and carefully "hinged" down on to the bromide. The two are then thoroughly squeezed together by several strokes in each direction.



DRAINING THE TISSUE. The tissue is first put in the No. 1 bath and then drained for 15 seconds as shown



SECOND BATH. The tissue is then slid into bath No. 2 for about 15 or 20 seconds

Great care must be taken during this operation to see that no movement takes place between the pigment paper and the bromide, otherwise a double image will result in the finished print.

It is further necessary to make quite sure that the pigment paper overlaps the bromide image all round. When this has been done the adhering pigment and bromide papers are placed under slight pressure, such as a few blotting boards, and preferably between sheets of waxed paper, as this prevents evaporation and so assists the action of the chemicals. They are left for about 15 minutes under pressure and then stripped.

Then the pigment and bromide papers are gently stripped apart. The bromide print is dropped into clean water to be subsequently dealt with and the pigment paper placed on the transfer paper, which has previously been taken from the soaking water and laid, prepared side upwards, on to the sheet of glass. These two are then squeezed together and again placed between the blotting boards, this time without the waxed paper, and left for about 20 minutes. Movement between the pigment paper

and transfer paper is of no particular importance.

DEVELOPMENT

The procedure from now onwards is the same as described in the development of the carbon print. The pigment paper and bromide are removed from the blotting boards and placed in a tray of water at about 95° F., the pigment paper uppermost, and left until the pigment begins to ooze out all around the edges. This is the signal for gently stripping the two apart—care being taken to keep them under the surface

of the water while doing so. The pigment paper is now thrown away, and development of the carbro image, which has been transferred to the support paper, is completed by gently splashing it with the warm water until all superfluous pigment has been dissolved away. A certain amount of control is again possible at this stage, as highlights can easily be brightened up and the density of shadows reduced by slightly hotter water. Care must be exercised in doing this, otherwise the highlights and delicate half-tones may be washed out.

When development is complete the print is rinsed in cold water and transferred to a



ON THE GLASS. The bromide print is now placed face upward on the glass sheet and the tissue, removed from the second bath, is placed onto it

CAREERS IN PHOTOGRAPHY

3 or 5% solution of potash alum, which will discharge the bichromate stain left in the transfer paper. When all traces of yellowness have disappeared the print is rinsed in several changes of water and hung up to dry. This latter stage should not be hurried, otherwise there will be a tendency for the print to wrinkle unduly. While the carbro print is wet it is very delicate, and the surface should on no account be touched.

When the pigment paper has been stripped from the bromide print, the latter will be found to have bleached out to a pale yellow color, though some of the deeper shadows may not have been so affected. The bromide, after a thorough washing, is redeveloped—no further fixing being necessary—and is again washed, after which it will be ready for making further carbros or it can be dried and put away for future use.

Instead of developing the carbro image on a new support, it is quite possible to do so on top of the bromide print and so avoid transferring. In this case it is essential to mask the negative before printing so as to give a white safe edge to the print. The procedure is the same as in the carbro up to the point where the pigment paper should be stripped from the bromide. Instead of doing so, however, at the end of 30 minutes' contact the two should be placed, still adhering, into the hot water and developed straight away. A picture of a composite nature is then formed, with the carbro image on top and a bleached bromide underneath. It is not advisable to leave it in this condition, as the bleached image may change color in time. It should be washed and fixed in plain hypo, or better still hypo and ferricyanide, and finally should be well washed again.

As an alternative, the silver image is redeveloped under the carbro, thus reinforcing the latter image. This method is useful when dealing with an underexposed negative which will only yield a weak print.



THE TRANSFER. After squeegeeing the print and tissue are placed between wax paper for about 15 minutes. The tissue is then placed in contact with a piece of soaked transfer paper—and the procedure is then the same as that of carbro

Many unusual effects may be obtained by combining pigment papers of suitable tones with the black bromide print.

CAREERS IN PHOTOGRAPHY

C. B. Neblette

*Administrative Head of Photography Technology,
Rochester Athenaeum and Mechanics Institute,
Author of Photography, Principles and Practice;
Co-author of Elementary Photography*

Some fields of photography are overcrowded, while others are almost begging for workers. This photographer and administrator discusses almost every photographic field from the vocational point of view—portrait, news, commercial, advertising, color work . . . motion picture and aerial photography . . . photographic work with the sciences . . . photo copying and finishing . . . travel . . . teaching . . . graphic arts . . . selling photo materials . . . writing and editing.

See also articles on special fields (i.e. Advertising and Illustrative Photography, Aerial Photography, etc.)

THE INFLUENCE of photography is felt in one way or another in almost every field of human endeavor. The many applications of photography to modern living and the steady succession of new applications, is sufficient evidence that there are, and will be, opportunities for men and women for careers in photography. These careers are not by



MAURIE WEBSTER. Maurie Webster's is one of photography's most interesting careers. He is the well-known conductor of *The Camero Club of the Air* in Hollywood and he is also proof of the fact that there is always something new and different in the photographic field

any means confined to those fields of professional photography—namely, portrait, commercial, advertising, and press photography—which have received by far the greatest amount of attention. There are many fields which today afford the opportunities for a successful and fruitful career. Some of these, as for example, portrait photography, are already crowded. In these, only by superlative work and a high degree of initiative can one hope to achieve real success.

Others, such as photo finishing, involve chiefly employment of a routine character. In general, people in these lines require little photographic training and receive little pay. Other fields, for example photomicrography, are highly specialized and usually require extensive knowledge of some other field. In a few fields of photography, as for example photoengraving and motion picture work, membership in a union is important. In some cases, as in portrait photography and to perhaps a lesser degree in the other professional fields, success in its larger aspects is, generally speaking, attainable only if one establishes a business of his own.

Naturally, in considering the opportunities for a career in different fields of photography, generalizations must be made and taken with a grain of salt because local conditions vary. In one community, for instance, there may be a crying need for a portrait studio, even though the field in general is overcrowded. There are, too, many smaller phases of photography not covered here. But it is safe to say that a great majority of businesses and fields of science can use photography in some way or another.

PROFESSIONAL PHOTOGRAPHY

Portrait Photography. According to the best available statistics, there are approximately 11,000 studios in the United States which are either wholly or primarily engaged in portrait photography. This appears to be approximately twice as many as in commercial photography, the next largest professional field.

Portrait photography was for years by far the most important branch of photography. In recent years, however, it has not been an easy one. The competition of other—and better advertised—products has tended to cause the general public to buy fewer photographs. The widespread growth of amateur photography has undoubtedly had its effect. Portrait photographers themselves, too, are not wholly without blame. Questionable methods have been employed to secure business, and these have tended to destroy public confidence.

The merchandising methods of portrait photographers as a group, have not kept pace with modern trends in other fields. While there have been many notable exceptions, the average portrait photographer has shown little regard for changes in public taste and outlook. Sensing the reluctance of the average professional photographer to adopt modern methods of merchandising, large, chain-managed organizations have entered the field with studios in department stores and elsewhere, and have become an important factor in the business.

While portrait photography cannot at present be said to be in a flourishing condition, it would be a mistake to consider that it is devoid of opportunity. There will

CAREERS IN PHOTOGRAPHY

always be a demand for portraiture and one who is sincerely interested in people and in portraiture should not overlook the possibilities which still lie in portrait work of a better kind. The varied difficulties which surround the field in themselves create an opportunity for the man of real ability.

The portrait photographer should above all things be interested in people. He should be a close student of human nature. If he is, he will have a real satisfaction in endeavoring to reveal in his photograph the inner personality before the camera. The portrait photographer must be a man of culture and refinement for he will deal with people of means and culture, and he must be able to meet them on their own ground—to feel at home with them and to make them feel at home with him—in order to gain the understanding of the individual.

Therefore, no one who is deeply interested in people and feels the urge to undertake portrait photography as a career, should hesitate even though it appears less promising than some other field. The future of portrait photography, of the right kind, is as bright as that of any field of professional photography.

Commercial and Advertising Photography
Commercial photography may be defined as the making of photographs for commercial purposes. It includes the photography of interiors, exteriors, show windows, and all kinds of manufactured articles. Ordinarily the objective of commercial photography is to produce an accurate, detailed representation of the subject photographed. So much of the work of the commercial photographer is used for advertising purposes that it is becoming increasingly difficult to distinguish



PORTRAIT PHOTOGRAPHY. An old stand-by in the photographic field is the portrait photography profession, yet there is still room for men and women with new ideas or technics. Here is a photographer getting a good shot of a baby—always a difficult job
Photo, John Muller



CAMERAMAN SILHOUETTE. This striking picture is symbolic of the commercial photographer's career. From the skyscraper high above the street to the mines underground, the photographer is expected to take good pictures. It is hard work—but worth it
Photo, Roy Pinney

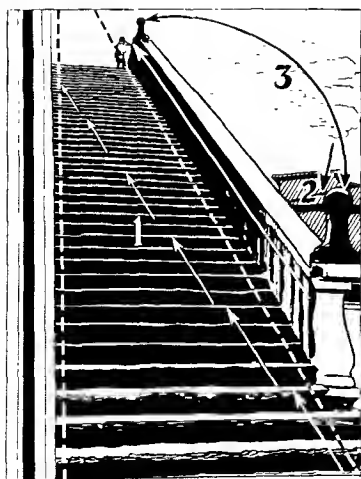
between advertising, or illustrative, photography and that which we generally describe as "commercial." Illustrative photography is essentially imaginative, dramatic representation. The growing trend towards the use of the techniques of illustrative photography in general "commercial" work means that those interested in this field should be per-

sons with imagination, a high degree of creative ability and ingenuity, coupled with appreciation of the principles of composition and design.

According to the best available data, there are approximately 7,000 commercial photographic studios in the United States. The number of advertising photographers is much smaller, being about 1,500.

The commercial photographer, in general, works with the customer. The advertising photographer, on the other hand, works with an advertising agency rather than the customer. The commercial photographer is expected to produce an accurate and literal representation of the subject. The advertising photographer, in general, is allowed much greater freedom in the handling of the subject. He ordinarily works on a larger budget and is paid more per print than the commercial photographer. On the other hand, the advertising photographer's expenses are much greater owing to the larger establishment required to meet the more varied demands, the smaller number of assignments which can be undertaken, and the larger number of re-takes often necessary to meet the approval of the advertising agency. The effectiveness of large advertising campaigns involving huge sums of money depend, to a considerable degree, on his work. The responsibilities, accordingly, are great. And so is the nervous strain, the harried experience of meeting the inexorable deadlines.

(Continued on page following insert)



COMPOSITION ANALYSIS for . . . STEPS AT ASSISI

This is a bold picture and, as all bold pictures, it is on extremely simple plane. There are but three units: the steps, the house, and the clouds. (It would help the picture if the figure atop the steps were omitted.)

But notice the infinite variety of details, of similes, and of contrasts which give this composition its rare quality. There is, for instance, the decorative stone ball in the foreground which, if photographed against a light background, would be a noisy repetition of the one on top of the steps.

Or take the endless change of the narrow strips of light as they run up the steps but are interrupted again and again by the massive weight of darkened stone. As drawn by a magnet, the eye follows it step by step, helped by the accompanying line of the banister.

The staggered effect of the steps and the gradual reduction in size give a perfect idea of depth. The illusion of movement is obtained by the diagonal. All this helps to create the sensation of infinity.

In such a sublime setting, a simple parallel line that between the horizontal line of one of the steps and that of the top roof, is disturbing. The lower roof, with its diagonal line, has better angular justification.

The moral for the photographer is to watch for the fine points of contrast and comparison in even the simplest picture. For it is exactly these oft-neglected points which make for the outstanding quality of his composition.

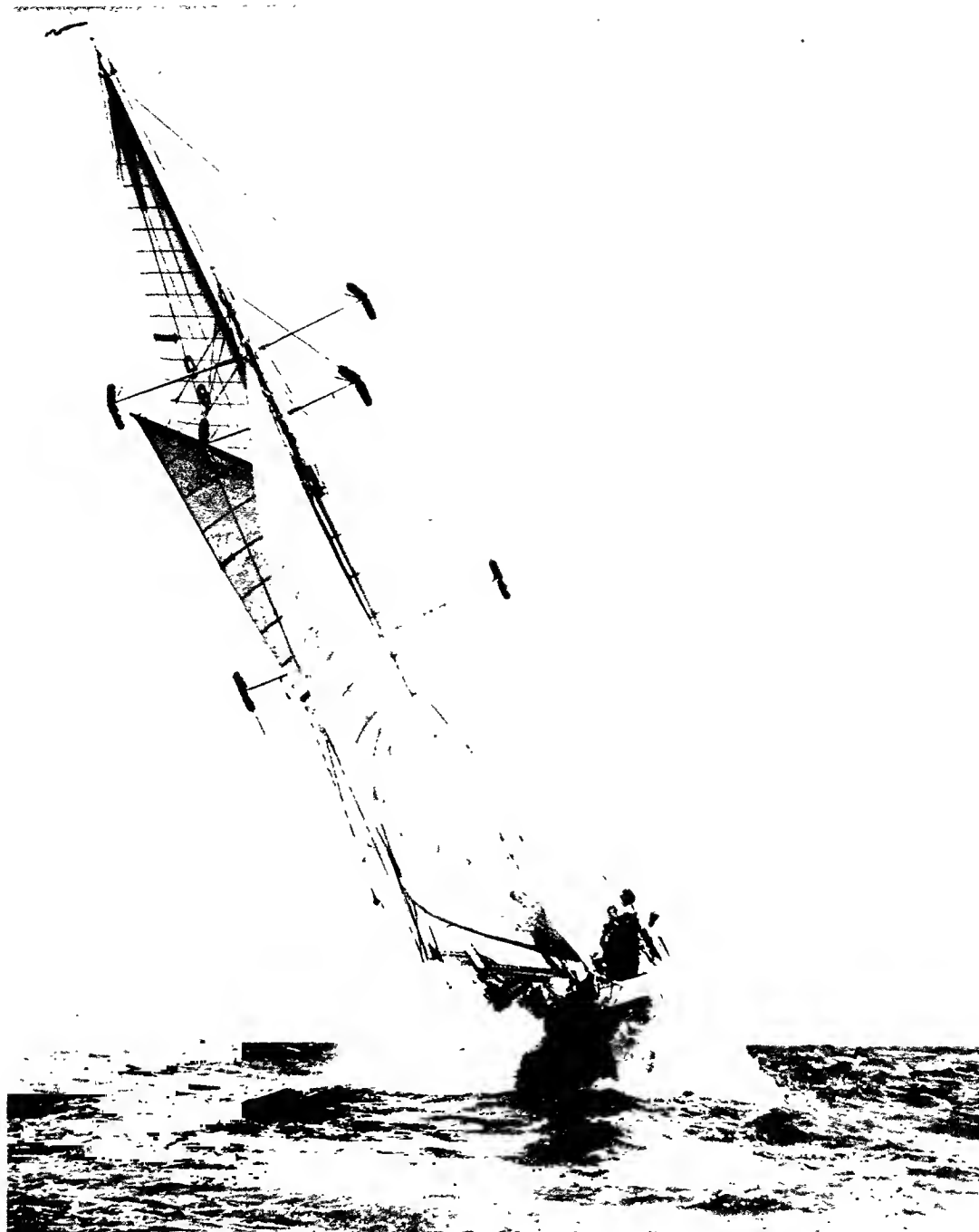
Gerhard Hirschfeld



STEPS AT ASSISI

FRITZ HENLE

This photo shows the stairway, at San Francesco in Assisi, Italy. DATA: Linhof 9 x 12cm camera, fast pan film, 1 second, f/32, light yellow filter



LEAD BOAT

JOHN LEVICK

This photograph shows the yacht "Mistress," owned by George E. Roosevelt, taken while she was the lead boat in a race off Newport. Marine photographs are extremely hard to get—especially in a 30 mile breeze—and perfect composition such as this is rare. Notice how the position of the man on deck and the spray, as well as the angle of the sail, all contribute to the impression of action. See Mr. Levick's article on Marine and Yachting Photography.

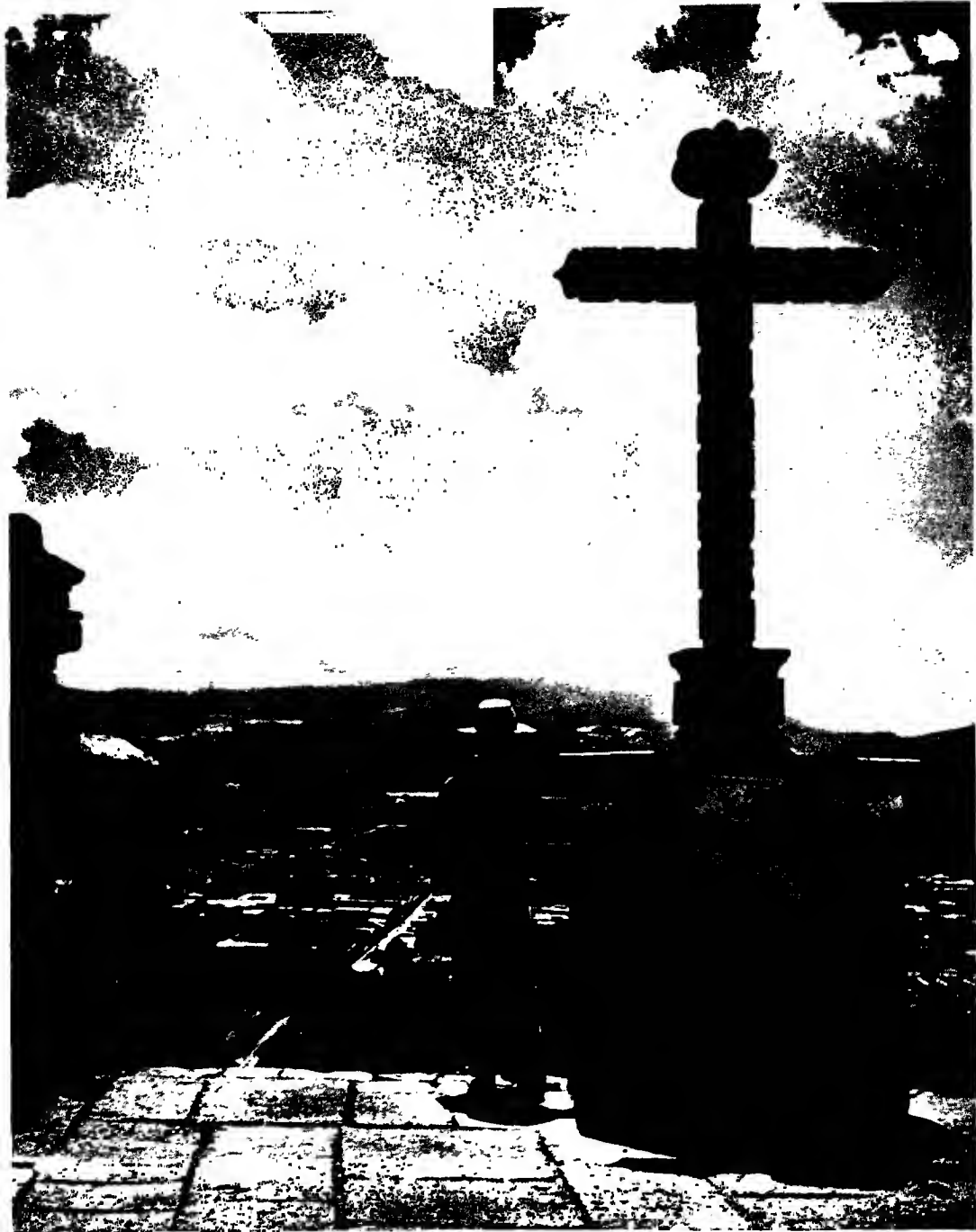
DATA: 4 x 5 Speed Graphic, fast pan film, 1/200 second, f/16, K-2 filter



SPEEDBOAT

DMITRI KESSEL

This effective photograph is composed on the extremely simple diagonal. There is enough variety in the surrounding water—with shadows and wave caps—to provide interest, but the entire picture is the boat and its wake. Taken from a bridge. Notice that although the boat is not in the center of the picture, the eye is drawn to it by the shape of the wake. DATA: $3\frac{1}{4} \times 4\frac{1}{4}$ camera, medium pan film, $1/200$ second, $f\ 8$



VISTA

DON NIBBELINK

The warmth and calm of a Latin American landscape are captured in this filtered shot. The silhouetted cross and the puffy white clouds make the sky interesting and important; the figure of the man and the larger mass of architecture at the left give meaning to the foreground. Taken by Mr. Nibbelink while a student at Rochester's Mechanics Institute. See *Landscape Photography, Travel Photography*. DATA: Rolleiflex, Tessar f/3.5 lens, medium fast pan film, 1/50 second, f/6.3, red A filter

CAREERS IN PHOTOGRAPHY

(Continued from page preceding insert)

Competition is relatively keen in both commercial and advertising photography. The first is, of course, much the larger field, both from the standpoint of the number engaged and the volume of business. There is much less price cutting and other questionable business practices in both of these fields than in portrait photography, and considerably more energy and ingenuity are displayed in discovering new uses for photography and new sources of business. There is greater originality in the photography itself. While there are a number of large organizations in both fields, there are none so widespread which offer competition of the same character as those in the portrait field.

While no exact figures are available, it is probable that the volume of business in both commercial and advertising photography has been increasing more rapidly in recent years than in portrait photography and that, in general, the volume of business of the

average commercial studio exceeds considerably that of the average portrait studio.

While there are fewer commercial than portrait studios, the possibility of obtaining employment is at least as good and probably better, because of the more active nature of the business, the number of divisions of the business requiring special skills and experience, and the fact that, on the whole, studios engaged in commercial work are larger organizations than those in the portrait field. The salaries for capable assistants tend likewise to be above that of the portrait field.

On the other hand, should one wish to go into business, the difficulties in finding a suitable location are rather greater than in the portrait field. Commercial photography depends for its existence on business and more particularly on industrial activity. In general, therefore, small towns and particularly those in areas essentially agricultural in character which may offer real possibilities in portrait photography, are not suitable for



MUKY MUNKASZI. This professional photographer is taking shots of the movie star, Brenda Marshall—a job that any photographer would want. In a difficult career such as publicity photography, however, extreme care and natural skill are needed.

Photo, Knopf-Pix, Inc.



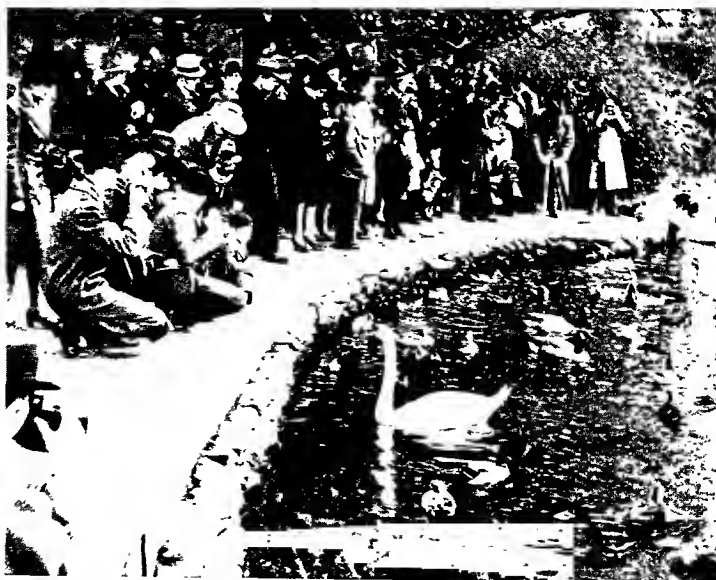
RURAL PHOTOGRAPHER. While most photographers flock to the cities and set up studios, there is still great need for photographs representing rural America. The photographer who knows his farming and cattle should go for
Photo, Robert H. Jacoby

a commercial studio. Since the advertising photographer works with the advertising agency, the majority of which are in the larger cities, he must almost of necessity be in one of the largest cities, and it is in these that the competition is the keenest.

Statistics are not necessary to call attention to the growth in the use of photography for advertising illustration in recent years. Photographs carry conviction! For that reason, they are in general more vital than other forms of illustration. Photographs, however, do not meet every advertising requirement. It has not shown itself well adapted, for example, to advertising illustration based on appeal to humor. It is possible, although there is no indication of it now, that there may be a decline in the use of advertising photography in a few years, as a natural reaction to its

widespread use today. So far as the large national advertising campaigns are concerned, the illustrative photograph is the product of relatively few photographers. Large sums are involved for advertising space, and the agency naturally hesitates to place an important assignment with a photographer who has not already demonstrated his ability to make pictures. Because of this, it is very difficult to break into advertising photography, and there are many advertising photographers today whose business would be far more successful financially, were they to concentrate more on general commercial photography.

News Photography. It has been estimated that, in the past 10 years, the space devoted to pictures in newspapers has increased over 400%. The demand for news pictures—and



THE AMATEUR. Most professional photographers served their apprenticeship in the amateur world—with or without the help of a camera club or a photographic course. After the first few pictures are sold, perhaps to friends, then free lance work begins and it is here that the professional and amateur photographer part company
Photo, Roy Pinney

CAREERS IN PHOTOGRAPHY

good news pictures has made news photography one of the most interesting of the photographic careers. Photographers may work either through a newspaper as staff photographer, through a news service or syndicate, or in the free lance field.

A news photographer must be both photographer and reporter. It would be hard to say which was the more basic and important training—the journalistic or photographic, as some famous news photographers have left the reporter's desk to assume their responsibilities and some have climbed the photographic ladder through free lancing. It seems to be clear, at any rate, that the way to break into the news field is to start in a small way either by being staff photographer to a small newspaper or by submitting articles to rotogravure and feature sections as a free lancer.

Then, too, there is the ever-expanding and somewhat different field of photographic journalism which is represented by the picture magazine. Here, as in *Life* and *Look*, the photographers are expected to cope with rather more difficult problems and to see



NEWS PHOTOGRAPHER. Benjamin M. Turner of Oklahoma City's *Oklahoma Times* is shown wielding o Big Bertha. News photography is exacting but interesting work and there is room in the field for specialization. This photographer, for instance, is an expert of sports photography
Photo, Harold Hahn



GETTING AN ANGLE SHOT. This photograph shows a cameraman of Pix, Inc. during a precarious moment in his picture taking career. The professional photographer must be ready to go almost anywhere—and cope with many photographic problems

their assignments in a somewhat broader light. The best photo-reporters may be sent on long and independent assignments to South America or China; they may be given only a general subject and they are expected to take the editorial initiative. In both magazine and newspaper photography there is room at the top for the worker who takes pictures effortlessly and well and who has an interest in people, in news, and in social trends.

Color Photography At present, professional color photography is more or less restricted to advertising photography. And in reality, it may be regarded as a separate branch of advertising photography. With the more or less continual improvements in the processes of color photography, however, its use will become more and more general, and it is altogether probable that within a very few years every commercial, advertising, or portrait photographer will be expected to undertake color work. In view of this trend, therefore, it would appear that color photography should be regarded only temporarily as a separate field. At the present

time, there are two major positions in the field of commercial color photography—photographer and color technician. The work of the color photographer is similar to that of any other, except that he must have greater appreciation for the use of color and the technical ability to make color separation negatives from which good color prints can be made.

The color technician is responsible for the processing of the negatives and the produc-

limited training in photography. The business is highly seasonal—the rush season extending from Memorial Day to Labor Day—and during the winter months the staffs may be reduced. Employment, except for the more skilled workers, is uncertain. Salaries, in general, are relatively low.

Motion Picture Photography. There is perhaps no field of photography which appears so attractive to the average young man or young woman as motion picture photography. So far as the larger studios of Hollywood are concerned, the field is highly competitive. Membership in the photographer's union is important. At the present time, it is almost impossible for the newcomer to "break in" to any but positions which are routine in character. There are opportunities in the production of documentary, educational, and advertising films, and the young man or woman seriously interested in a career in this field should consider these first.

In the processing of motion picture films, there are a number of positions requiring specialized photographic training. In addition

to the production foreman, there are other foremen in production sensitometry, negative processing, printing, print quality, timing, and special effects.

SPECIALIZED BRANCHES

Aerial Photography. Aerial photography may be divided into two classifications: oblique views and aerial survey (map making). Oblique views are widely used by industrial plants, park commissions, city planning commissions, etc. for publicity, for purposes of valuation, studies of traffic control, terminal facilities, etc.

Aerial survey photography, or map making, is utilized for location of high tension transmission lines, geological and natural resources surveys, city planning, tax valua-



PHOTOFINISHING. Most amateurs and some professionals have their processing done by photofinishers. The "drug store" photofinishing is not particularly creative or lucrative, but better plants need good technicians
Photo, Roy Pinney

tion of the final color print. At present, this is a highly specialized field and capable technicians are well paid, although they are subject, in general, to frequent lay-offs arising from fluctuations in the amount of color work utilized in advertising.

Photo Finishing According to estimates, there are some 5,000 photo finishing establishments in the United States. In addition, many portrait and commercial photographers, especially in smaller towns, do developing and printing for amateurs. The margin of profit is small, and a relatively large volume of business is necessary. In large plants, processing machinery is extensively employed and there are but few skilled workers, the majority of the employees being young women with only a

CAREERS IN PHOTOGRAPHY

tion, flood control, other engineering projects, and general mapping. As compared with ground survey methods, aerial survey makes possible the production of accurate, detailed maps at a lower cost and more rapidly than other methods of map making. Aerial maps, however, must be based upon preliminary ground surveys to which the photographs from the air must be accurately fitted to form the completed map. The actual amount of photographic work is thus comparatively small, the number employed in engineering being far greater. While aerial photography, insofar as oblique views are concerned, is largely open to anyone having the proper equipment and training. Aerial surveys require a large organization and a highly skilled personnel. A great deal of aerial mapping is done by the federal government. Private activities in this field are largely confined to a few organizations.

Astronomical Photography Nearly all important observations are now made by photography, and the astronomer's telescope is more of a special form of camera than it is a visual instrument. There are, however, practically no opportunities in this field except for one who has been trained in astro-physics.

Criminal Photography While photography has come to play a very important part in criminal investigation and the Police Department of practically every large city has a photographic department, there are comparatively few opportunities in this field. Difficulties are encountered in obtaining the specialized training required, since usually the only chance of obtaining employment in this field is through service on the police force. There are some few opportunities for consulting specialists, but these should be properly considered as a branch of legal photography.

Legal Photography. Photographs are often offered as evidence in court proceedings, and in many cases have a very important bearing on the outcome of the case. Photographs for legal purposes must be sharp and clear, free from distortion, and present situations or conditions in such a way as to indicate convincingly what has happened. Full data as to time of day, position and height of camera, position of subject, and all other



HOLLYWOOD CAREER. The apprenticeship of a Hollywood cameraman is difficult. His job is strenuous and there is no room for error. But the work is interesting and lucrative. Other jobs are also available on the studio set—and who wouldn't like the fun of pouring water onto a movie hero's face
Photo, Paramount Pictures, Inc.

information which may be pertinent, must be carefully recorded. The photographer must likewise be familiar with court procedure as he will be required to take the stand and explain the photograph and conditions under which it was made. He must be able to explain technical matters clearly and accurately to the jury which is frequently entirely unfamiliar with such matters. While, in general, there is some difficulty in securing sufficient business, men of the necessary qualifications, who are able to gain the confidence of the legal profession, are well rewarded.

Medical Photography Photography has much to contribute to the progress of medicine, and there is a definite need for good medical photographers. But until the medical profession appreciates this fact and is willing to pay more than a living wage, it does not offer much of an opportunity from a financial standpoint. In the average hospital, various members of the staff do at least some of their own photographic work, and some may be done by the X-ray

technician. Only in the larger hospitals, and generally those which are a part of a medical college, is there likely to be a photographic department with a photographer. His duties will include photographing unusual cases, operations involving special circumstances and technics, photomicrography, and making enlargements and lantern slides of these for lecture purposes.

In addition to a thorough preparation in photography, the logical preparation for medical photography would include a thorough grounding in histology, microscopic technic, scientific drawing, physiology, bacteriology, and topographical anatomy. The course in histology provides a thorough knowledge of the tissue structures and the various stains used to delineate cellular elements. Obviously, if a photographer does not appreciate the manner in which cellular elements should be reproduced, the resulting photographs will not possess a great deal of information. This is true of any specialized photography—you have to know photography *and* the special field.



DOCUMENTARY PHOTOGRAPHER. A phase of photography which is growing in importance is the documentary field. Documentary motion pictures are sponsored largely by the government, private industry, visual education societies, and now Hollywood. Shown here are Pare Lorenz and his crew on location for *The River*

A survey of salaries in this field shows that the maximum which can be reasonably expected is about \$4,500 per year, with the average much lower—probably between \$100 and \$150 a month. One should enter this field, therefore, only if the opportunity to be of service outweighs the financial reward.

Natural History Photography. In general, scientific training is necessary if one is to be successful in making a career of natural history photography. With the proper scientific background, one may find employment with scientific expeditions, state and federal departments, museums, and research organizations active in the field. The United States Department of Agriculture and the various state colleges of agriculture, for example, afford some opportunities along this line.

Photo Copying. Photographic copying may be divided into two divisions: 1. The copying of documents on sensitized photographic paper, as with the photostat, and Rectigraph machines; 2. The copying of similar material at a much reduced scale, usually on rolls of 35 or 16mm film for use in reading instruments. The photostat and similar machines are widely used in making photographic copies of drawings, books, newspapers, charts, constructional plans,



SCIENTIST-PHOTOGRAPHER. This shows Charles E. Mohr of the Philadelphia Academy of Natural Sciences at work underground—photographing a bat. Science has an almost infinite need for scientific photographs taken in the field or in the laboratory, and the scientifically minded will find it interesting work

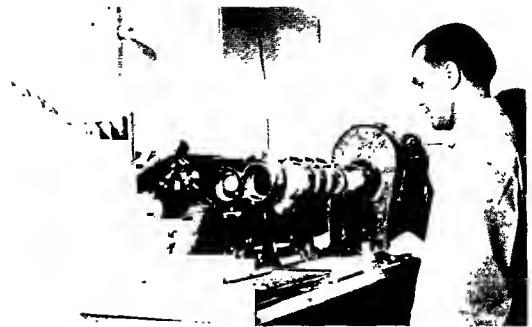
CAREERS IN PHOTOGRAPHY

and other written or printed matter. Such copies are accepted by courts as facsimiles of the original. The machines are relatively simple in operation and require little knowledge of photography. There is, therefore, no real scope in this field.

Microphotography is being used extensively because of its low cost and because it enables voluminous printed material, such as yearly volumes of newspapers, to be reduced to a small roll of film. Film copies of out-of-print materials can be made for distribution to those interested far more cheaply than in any other way. For example, more and more of the rare manuscripts from the Vatican library, as well as others, are being constantly made available to scholars throughout the world through the medium of film copies. Most of the larger progressive libraries of the world have begun to make use of film copies and have installed reading equipment for the use of such material. There are good opportunities for careers in this relatively new but rapidly expanding field.

Photomicrography. Photomicrography is properly defined as that branch of photography which consists in photographing microscopic objects with the aid of the microscope. It should not be confused with microphotography, which is the making of photographs on ultra-small negatives (described above). Photomicrography is a very important tool of science and industry, and finds applications in bacteriology, biology, cytology, histology, metallurgy, and chemistry, as well as in many branches of engineering. For the most part, it is a highly specialized field which demands extensive training in that branch of science or engineering in connection with which the work is done. Thus in most cases, the work is done by research specialists as a means of obtaining records of their results. In a lesser number of cases, full time photographic technicians are employed, working in close cooperation with the specialists for whom the work is done. Thus, despite the very great importance of photomicrography in scientific investigation, there are comparatively few opportunities for the specialist in this field, unless he can qualify also for research work in another field.

Teaching Photography The opportunities in this field at the present time are almost negligible. Only a small number of colleges and universities offer any instruction whatsoever in photography, and where offered, it is usually dependent for its existence on the presence of the faculty of someone interested in photography and its application to the field of education which he represents. It appears probable, however, that this situation may change materially within the next few years. Courses in photography, as applied to engineering and other fields of science and technology, would appear to be



PHOTOMICROGRAPHY. In hospitals and scientific research laboratories the work of a photographer is important. As in clinical photography, the opportunities for women are good. Shown in the illustration is a photomicrography set-up, a complicated arrangement of lenses, lights, and holders, useful for photographing germ cultures, skin tissues, or perhaps blood analyses

Photo, Roy Pinney

inevitable. With the present wide-spread use of photography in almost every branch of science and technology, one cannot be regarded as fully prepared without some knowledge of it. A college degree is virtually a necessity in obtaining a teaching position.

Many high schools have camera clubs and, in an increasing number, short courses in photography are being offered for which credit is being given. In practically all cases, the instructor is a member of the faculty in the arts or the sciences. There do not appear to be many opportunities in this field, unless one is prepared to spend the major portion of his or her time in the teaching of other subjects.

In the technical, vocational, and continuation high schools in the major cities, however, the opportunities are somewhat greater. Most of these are either directly or indirectly



X-RAY TECHNICIAN. In clinical photography the work of the X-ray operator is extremely vital, as more and more diagnoses are helped by the X-ray photograph. This branch of photography can be, while not a lucrative career, at least an interesting one
Photo, Roy Pinney

representative of travel companies, but these are not, properly speaking, careers in photography.

Writing and Editing The number of photographic magazines is now such that the possibilities of a career in the writing and editing of photographic material are sufficient to warrant serious consideration. For a successful career in this field, one should be not only thoroughly conversant with photography, but also have some journalistic experience. At the present time, there are few professional writers in photographic journalism, most of the material coming from free lance writers who are more or less actively engaged in photog-

raphy, and to whom writing is incidental. This undoubtedly will continue to be the case for some time. However, there would appear to be a few opportunities in the editing of photographic materials.

X-Ray Photography. The widespread use of X-ray photography for diagnostic purposes in the clinic and hospital and by dentists, is well known. Less well known to the general public is its use in industry in determining the properties of various metals, alloys, and constructional materials, and in detecting flaws and imperfections. While this is a highly specialized field, it is one which has developed rapidly within recent years. There would appear to be some opportunities in this field, but as in other specialized branches of photography, the photographic training required is secondary in the sense that one must be trained primarily for the particular field to which photography is applied.

Travel Photography A number of magazines, among which *The National Geographic* and *Life* are outstanding examples, maintain a staff of photographers who are sent from place to place. Photographs of foreign scenes or people are also purchased by magazines and agents from publishers' agencies, who in turn have secured them from their staff men or representatives. Generally speaking, it is difficult to commercialize on travel photography sufficiently to make it a paying proposition, unless one is fortunate enough to obtain a position as a member on the staff of a magazine or picture agency. From time to time, there is an opportunity to accompany a scientific expedition. These, if private ventures, often require one to contribute to the expenses of the expedition.

There are possibilities as a speaker or writer on travel topics or as the advertising

RELATED FIELDS

Blueprinting. This field is included only because it makes use of a photographic process. It is not generally considered as a branch of photography. Printing today is almost entirely by means of continuous

CAREERS IN PHOTOGRAPHY

machinery and requires little photographic training.

Graphic Arts Photoengraving, rotogravure, and offset are not usually considered as branches of photography. However, since all three involve camera work and photographic processes, their inclusion in this survey of the opportunities for a career in photography appears justified.

It is estimated that there are approximately 15,000 employed in photoengraving in the United States, with an annual output valued at \$100,000,000. Approximately $\frac{2}{3}$ of these are members of the photoengraver's union. A five- to six-year apprenticeship in a union shop is required by the union as a condition to union membership. Thus, without a lengthy apprenticeship, it is difficult, regardless of training, to secure employment. Camera men ordinarily receive from \$50 to \$60 for a 40-hour week. Men in other positions are paid accordingly.

According to the latest figures, there appear to be from 15,000 to 20,000 in photolithography and offset, with an annual production estimated at \$200,000,000. This field has grown rapidly. However, only a few in these branches of the graphic arts are engaged in actual photographic work.



COMMERCIAL COPYING AND PHOTOENGRAVING. A little known but important part of photography is the copying work involved in the photoengraving process and in general commercial work. Here is a worker using some of the elaborate equipment
Photo, Roy Pinney



OPTICAL WORKER. In a furnace of 1600° temperature, lenses are molded by expert workers. For such work a good basic training is needed
Photo, Eastman Kodak Company

Gravure is confined almost exclusively to newspapers and advertising folders and booklets of the better class, and where large editions are required. The bulk of the work is done by relatively few large plants. No data as to the number of photographers employed is available. It would appear to be less than 500.

PHOTOGRAPHIC INDUSTRY

Manufacturing Approximately 35,000 people in the United States are engaged in the manufacture of photographic equipment and sensitized goods. The manufacture of sensitized goods is centralized in seven concerns. Photographic apparatus, however, is produced by a much larger number of firms, most of them small.

A wide variety of positions are found in the pho-



CAMERA MAKER. This Eastman Kodak technician is putting together lens parts. Work in the various plants which manufacture photographic equipment is open to men and women who can keep up with the strict standards of workmanship imposed by photography

tographic industry, many of which have little direct relation to photography. In the manufacture of cameras and equipment, for example, most of the work is of a mechanical nature and photography is involved only in the making of photographic tests in connection with the designing or testing of equipment. A background of training in machine design and instrument making is the best preparation for a career in this field.

In the manufacture of sensitized goods, many occupations are routine in character, others require advanced technical training. While in many of these positions a knowledge of photography and its processes is not essential, it is a decided advantage which has been recognized and encouraged by the major manufacturers for several years.

Selling Photographic Supplies There are about 1,700 recognized dealers in photographic supplies in the United States. This does not include drug and other stores, whose connection to photography is limited to the sales of roll film and small cameras. Salesmen in stores specializing in the needs of advanced amateur and professional photographers must be well informed and able to give sound and practical advice on photographic problems. They should also possess some knowledge of salesmanship and business management. Salaries depend upon ability and are frequently in part on a commission basis.

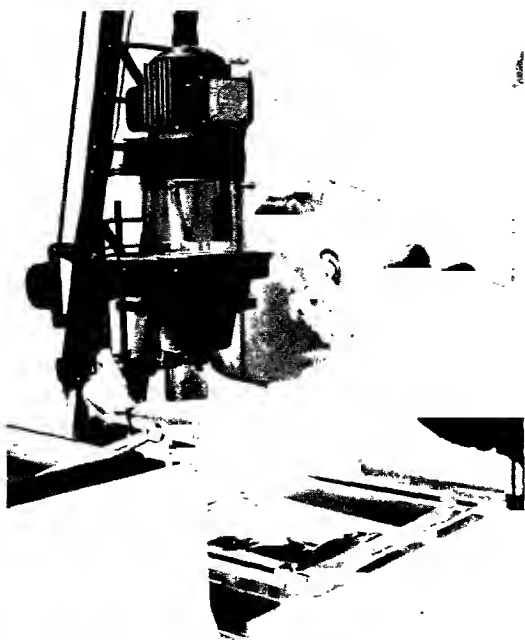
About 100 dealers are concerned almost exclusively with supplying the needs of the professional photographer. These generally employ a number of traveling salesmen who should be thoroughly familiar with the work and problems of the professional photographer.

The manufacturer's representative usually does not call on individual photographers but on dealers. The demonstrator calls on individual photographers. He is expected to demonstrate the use of the company's products and help the photographer with his technical problems, and is not a salesman in the ordinary sense. In general, the dem-



SALESMAN. A general all-around knowledge of photography—as well as the ability to sell—is required of a photographic store salesman. But it is a fascinating business, with all the latest in equipment to work with
Photo, Roy Pinney

CARICATURES AND DISTORTIONS



WOMAN PHOTOGRAPHER. Same of this country's most famous photographers are women—and the list includes Margaret Bourke-White, Ruth Nichols, Toni Frissel, Louise Dahl-Walfe, Berenice Abbott, Barbara Morgan, and many others. There is room for women in almost all fields of photography. (In this photo, a positive inserted in easel shows print position.)

Photo, Roy Pinney

onstructor must first achieve success as a professional photographer.

PREPARATION FOR A CAREER IN PHOTOGRAPHY

Any specialized training in photography should be based upon a good general education. High school graduation is a prerequisite for a career in photography.

There are, at present, no colleges or universities in this country offering courses in photography of the same character as those available for students of the classics, the sciences, or engineering.

The Mechanics Institute in Rochester offers three-year courses in professional photography and photographic technology which include, in addition, to the science and practice of photography, classes in related chemistry and physics, design and composition, advertising, advertising layout, retouching, sensitometry, etc. This institution, however, does not give degrees.

There are a number of privately owned and operated schools of photography offering instruction in the various branches of professional photography, but seldom in the more technical applications.

The vast majority of present-day photographers in practically all fields are either self-trained or have learned the craft through some form of apprenticeship. In general, however, conditions within the field are no longer favorable to apprenticeship training. Photographers for the most part are unwilling to teach others and largely lack the ability to do so. While valuable experience is gained through apprenticeship, the training which the student receives is often limited by prejudice or is based solely on individual experience. It seldom results in a well-rounded training program. Therefore, unless the aspiring student is especially fortunate in finding someone who really understands the field and is willing to impart what he knows—someone who has a broad knowledge in the field of photography and is also a good teacher—he will do better to go to the best school he can afford.

Certain fields, such as photoengraving and photolithography which operate under trade union regulations, have an established apprenticeship training system. At the present time, this is the only method of securing training for these fields which can be recommended.

CARICATURES AND DISTORTIONS

André Kertész

Commercial photographer, New York, Author of Paris, Vu Par André Kertész

Distortions in photography can be either extremely humorous or very serious. In either case, distortions are easily averted, seldom effective unless well thought out. The big feet "gag" picture is familiar to everyone. Here is a description of the various ways to distort the image for a purpose. It is by a man who is past master of the art—and it is an art.

See Also Tricks in Photography

DISTORTIONS, imaginatively conceived, form one of the highest artistic forms of photography. They have implications of literary, decorative, plastic, and artistic



A simple distortion by elongation is good for certain subjects. This one was accomplished by a distorting mirror, but a similar effect might have been obtained by tilting the easel during projection
Photo, André Kertész

significance. Finely executed distortions may be poignantly tragic or excruciatingly comic. They are the extremes of emotion. In this field there is no middle ground. Distortions are fantastic, gruesome, eerie, tragic or comic—each in an exaggerated degree.

Photographs capable of such strong emotional effects naturally have a place in modern advertising. Distortions have come into use commercially in the advertising of nationally-known products such as headache cures, corn plasters, and others. There is an even greater field in fashion work but as yet the editors of fashion magazines have failed to realize this.

Aside from their commercial uses, distortions furnish a wide field for experimentation among amateur photographers. Amateurs who play with distortions for the fun of it occasionally get results which are

unusual, spectacular, and artistic. In any case the serious photographer would do well to try some work of this kind. The individuality and originality of the photographer form the basis of this technic. There are few limitations placed on the imagination. Yet this very fact makes distortion an art and, in its highest form, a difficult one.

REQUIREMENTS OF FINE DISTORTIONS

In my opinion the most subtle form of distortion is accomplished by the use of concave and convex mirrors. These mirrors, of the type used in carnivals and circuses, produce unusual and spectacular effects. They make giants out of children and dwarfs out of tall men. The weird and unnatural effects which they produce make extremely powerful compositions. Still life and nudes are particularly effective when distorted by this method.

The viewer must not be left in the state of bewilderment which so often results from seeing the unrelated mass of curves, angles, lights, and shadows which compose the poorer distortion pictures. There must be an emphatic governing theme in every picture.

It is necessary that the photographer plan each subject differently. The lighting, pose, and composition must be kept true and consistent. If a fantastic subject is being photographed, it should be given a fantastic treatment. If the subject is humorous, it should be given a humorous treatment.

A primary rule of composition in distortion pictures is to eliminate all extraneous material. Even more than in ordinary compositions, extraneous material tends to be confusing and to distract from the center of interest. I use a solid arrangement of vertical and horizontal masses in most of my compositions.

All the elements of the picture must be considered together and simultaneously. The artist in the field of distortions cannot afford to think of subject arrangement alone, then lighting, then placing the mirror and choosing the camera position to be used. All these elements must be combined simultaneously when the distortion picture is planned and executed. This may be difficult at first but experience will do everything toward

CARICATURES AND DISTORTIONS

helping the serious worker to combine the various factors successfully.

One of the most important requirements of the fine distortion picture is that of sharpness and detail in the portions requiring such treatment. The photographer must attain extremely fine treatment of detail and sharpness. As small a stop opening as possible should be used. If distortions are to be successful the sharp areas must be razor-sharp and the out-of-focus areas must show that dizzy blurriness that is present in extremely soft focus. The whirling dizziness of the out-of-focus areas and the keen sharpness of in-focus portions make for a dramatic and striking picture because of the contrast.

PORTRAITURE BY DISTORTION

Portraiture furnishes a big field for distortion pictures. By exaggerating a person's features, the photographer can execute just as effective a caricature as can the cartoonist.

No matter which method a photographer uses to make his portrait distortions there is one fundamental rule: the ideal is to exaggerate the features in such a way that the resemblance is not lost but the outstanding and characteristic expressions are exaggerated and distorted until they become *more*, not less, like the model than he is himself. If the resemblance is lost entirely, the distortion is badly done. Every distortion my convex and concave mirrors give me is not always a good one. It is up to me to choose and plan the distortion best suited to the idea if it is to be a fine picture.

Portrait caricatures illustrate well an outstanding principle of good distortions. They can wander as far away from real life as is possible without actually losing the real meaning of the object or model. As long as they exaggerate the essential qualities of a property or a figure, they are authentic. They lose their whole meaning when they go so far from the essential characteristics that all resemblance to the original is entirely lost.



Still lifes are well suited to simple mirror distortion and such subjects as the flower shown here are good for beginners. There must always be a basic idea, of course, and careful planning is required to put this idea across
Photo, André Kertész

SET-UP AND EQUIPMENT FOR DISTORTIONS WITH MIRRORS

Every worker who undertakes distortions seriously will develop his own technics. In describing my own set-up for distortions with mirrors I am only suggesting one method.

The large convex and concave mirrors which I use are very difficult to get. They are manufactured in England and can be had now only at high prices. The mirrors must be fine ones. The more convolutions they have the better. For nudes and figure work the photographer really needs a mirror six feet by four feet in size. The large size is necessary because the photograph is usually only made from a portion of the mirror. When the model is set up in front of the

mirror, the photographer must arrange his lights, then choose his camera position in such a way as to record on his negative only that *portion* of the mirror which contains the composition he desires.

A small mirror—2 by 3 feet in dimensions—will do for still lifes.

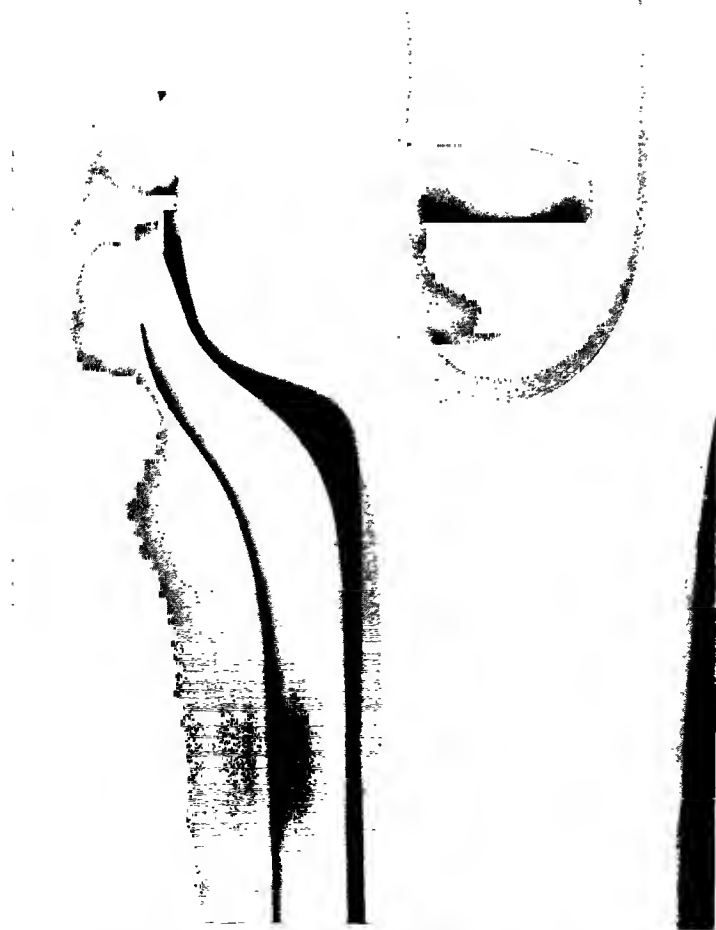
I use a blending of daylight and photoflood lamps. Usually one photoflood is sufficient. This light must be shifted back and forth many times before its reflections in the mirror are eliminated. The light must never show in the mirror as it will cast reflections into the lens. This lamp is usually placed at a 45° angle to the mirror.

The camera is placed in front of the mirror, either to the left or the right side. The accompanying photograph shows the mirror, model, and camera set-up that I like to use.

In my work I use the Hugo Meyer Latz Plasmalenses on a long bellows camera. The lenses are of five different focal lengths, permitting that many differences in perspectives—13½cm, 11cm, 14½cm, 22cm and 27cm. The choice of a lens for each photograph is almost as important to good distortions as the quality of the mirror. I sometimes take a single set-up with several different lenses, though as a rule I choose a single lens. This choice is as much a part of the composition as the placement of figure, properties, and mirror.

DISTORTION WITH THE LENS

While mirrors are the most effective means of distortion, they are not always either convenient or available. For interesting distortion of nearby objects in relation to far, the wide-angle lens is good. The angle of a normal lens is about 50°, while the average



This surrealistic photograph was actually "done with mirrors," an extreme variation of the simple mirror distortions shown with this article
Photo, André Kertész

CARICATURES AND DISTORTIONS



The weird effect of the double legs and double arms was obtained, as shown, by a mirror similar to those found in amusement parks
Photo, André Kertész

commercial wide-angle lens ranges from 70° to 90° . Wide-angle lenses, like swing adjustments on the view camera, are most often used to *correct* perspective distortion. But there is no reason why they cannot also be used to *create* perspective distortion, too.

The wide-angle lens has a relatively short focal length and therefore it increases the size of foreground objects far out of proportion to the size of background objects. Useful in giving a faithful image of an interior (when a normal lens will not cover the area), the results of purposeful distortion can be seen in such photographs as the portrait of "Schnozzle" Durante on page 657. Commercially this exaggerated perspective—a refinement of the gag "big feet" picture—is used often.

The ne plus ultra in wide-angle lenses is the 180° lens first perfected in England by Robin Hill. As the accompanying photograph will show, the lens actually does cap-

ture a 180° image, distorted, of course. The Robin Hill lens is really two separate lenses. The top lens contracts the incident angle of the rays to about 90° and projects the image onto a regular photographic lens. This last further contracts the ray angles, acting like a wide-angle lens, and projects the image onto the film. The resulting photograph makes an interesting shot, which is both a useful and amusing distortion.

DISTORTIONS FOR THE AMATEUR

Amateur photographers who wish to enjoy the fun of distortions without going into the field too seriously will find a variety of methods available to them. Subjects range from portraiture to still life.

One experimenter makes his distortion portraits through an ordinary water glass held close to the face—sometimes filled with water, sometimes only half-filled, to give a split-face effect.



The accompanying 180° photograph was taken with this Hill-Claud Camera—so-called because its inventor, Rabin Hill, first used it to take pictures of the whale sky. The camera, which bends the horizon rays to a 90° angle, can be very effective for distortion photographs. The camera has no shutter and must be uncapped and capped for exposure. Also the photographer must either lie flat on the ground or—in the case of an interior—leave the room (on the run!) during exposure.

Still another method of making distortions calls for the photographing of reflections, as they appear in automobile fenders or any bright reflecting surface that is not flat.

DISTORTIONS IN PRINTING

The most widely used form of distortion is accomplished in the printing or enlarging process. This method is used principally in distorting or caricaturing the facial expressions of people. The first prerequisite is a truly sharp, good quality negative.

Selection of subject material is important. Sometimes subjects which appear to hold no possibilities at all may, after study and arrangement, work into amusing bits of caricature. In addition to portraits, the straight negatives of such animals as cats, monkeys, giraffes, tigers, and others—also clowns and other characters—make good negatives for distortion pictures.

(Continued on page 657)



Ralph Steiner and Lea Hurwitz, photographers, are shown here in a self portrait, taken with the Hill-Claud Camera. This remarkable instrument, shown in an accompanying photograph, takes pictures at an angle of almost 180°.

CARICATURES AND DISTORTIONS

CARICATURES AND DISTORTIONS

(continued)

The technic of distortion in printing is simple enough. One method is that of tilting the easel, the other is accomplished by buckling the paper. For the first, place the straight negative in the enlarger in the usual way. Put a piece of white paper—possibly the back of an exposed print—on the easel. Then tilt the easel to one side and the other, from top and bottom, studying the effect until you see the desired composition and distortion. Perhaps the easel will be at a 45° angle, perhaps at a 70° angle. When you find the desired position, prop the easel into place, focus on the center of interest, cut the lens down to f 45 or smaller (to give depth of field and all-over focus) and make the exposure in the usual way.

The paper-buckling method is a little more complicated. Here the distortion is accomplished by bending the bromide paper in curves and waves—so that the light from the enlarging machine will strike the paper at strange angles. Heads and faces can be elongated or flattened, noses can be enlarged, eyes and ears and mouth stretched in this method. Fantastic and humorous effects can be achieved. But a good deal of practice is needed for this method of distortion, as the buckling is often unpredictable.

Use an extra sheet of white paper, again, to plan your composition. Buckle it out-

ward or inwards in the middle, turn one corner down, or up, experiment with different curves until you get the desired distortion. Then put a red filter over your enlarger lens and place the sensitive bromide



SCHNOZZLE DURANTE. Jimmy Durante, the comedian famous for his big nose, is portrayed here with a wide-angle lens. A caricature par excellence! Photo from *Life* by Ralph Steiner and Leo Hurwitz



For advertising purposes, distortion shots such as this are taken with an extreme wide-angle lens. They are seen most frequently in headache and liquor ads
Photo, Ralph Steiner

paper in the same position as the focusing sheet. You can use thumb tacks to hold the paper to the easel in the curved position. Allow about a half-inch of extra paper all round the sheet, in order to be able to trim off the thumb tack marks. When the paper is securely tacked down, focus on the center of interest, cut down the lens stop, remove the red filter, and make the exposure.

Dodging is an essential printing device in distortion work. It is necessary on tilted easels and on buckled paper, because the section of the paper which is furthest from the light coming through the lens will always need more exposure than those portions which are closer to the light. In the case of curved papers, the sections on the sides of the "slopes"—sections which the light hits



Slight distortions can be very effective, as this photograph demonstrates. It was taken with a wide-angle lens and exaggerates to a subtle degree the height and the "closing in" of the tall buildings. Says the photographer of this picture: "Inasmuch as Wall Street and that area had been photographed to death when crowded with people, I thought maybe without any people it might look different. Saw the narrow strip of light coming through the tall, heavy stone buildings and decided it might make a picture. The exposure was a compensation for the bright sunlight at one end and the dark stone buildings." Used by *PM* in a Sunday series of "How New York Looks To Its Photographer." DATA: 4 x 5 Press camera, 8cm lens, fast pan film, 1/75 second, f 11
Photo, David B. Eisendrath, Jr.

at an angle—will need more exposure than those portions which lie flat. A little practice will teach you how to secure an all-over exposure by giving extra light to the portions which need it. This control can also be effected sometimes in development by using warm developer on the parts that need bringing out. A fast bromide paper is recom-

mended for this work—one that will not call for long exposures.

NEW FIELDS FOR DISTORTION

In painting, distortion is limited only by the resourcefulness of the artist's mind—as surrealist paintings will testify. With photography, however, it is very different as there is the limiting influence of photographic technic, too. Aside from the technics mentioned, however, there are quite a few ways to achieve caricatures and distortions.

Color, for instance. We think of distortion in photography as consisting entirely of shape distortion—yet men like Nicholas Hays have done miraculous things with color distortion. Just as giants become midgets and vice versa with the distortion mirrors, so with different colored lights, tomatoes become blue and lettuce turns red. Here is an entirely new field for the grotesque or humorous in photography.

Then, too, there are new technics in black and white distortion. Valentino Saria, the famous photographer, has done many successful distortions for advertising purposes by stripping the emulsion from its base and laying it onto another base in curves and wrinkles. And

there is always distortion with the motion picture, a comparatively undeveloped field.

There are, as we can see, technical limits to new fields in distortion. And there are also definite esthetic limits. A distortion is either humorous or grotesque, or it evokes some other emotion. But there must be a definite purpose behind it.

CARRIER PIGEONS FOR NEWSPAPER PHOTOGRAPHY

David B. Eisendrath, Jr.

Staff Photographer, PM Newspaper

In the newspaper world, the scoop is all-important. Described here is an unusual way of delivering news photos—by carrier pigeon. The author, who is a newspaper photographer himself, shows that the pigeon is not only a fascinating part of the field of communication but also an important ally of the photographer who is out for spot news pictures.

All photographs show Chicago Times pigeon service

See Also Newspaper Photography

WITHIN the past decade, the use of carrier pigeons by newspapers throughout the country has been quite successful when used for transporting undeveloped films back to the newspapers by photographers out on assignment. At first used over water—for bringing in celebrity pictures from incoming ships in order to meet editions and beat rival papers—the use has spread to daily procedure on some papers, over land and heavy traffic as well as water.

Carrier pigeons will serve two major functions for a newspaper: first, they will create much excellent publicity, public interest, and curiosity. At football games I have heard announcers on both public address systems and nation-wide radio hook-ups interrupt a broadcast to explain that the crowd was oh'ing and ah'ing the release of pigeons which would carry pictures back to *The Daily Blah*, and invariably at sporting events, parades, and other mass gatherings I have been asked again and again, "Where can we see these pictures?" One paper has an annual contest to get names for its new birds—and the mail is heavy.

This, of course, is the lesser, though an important function of using pigeons. I do not want to say that carrier pigeons are good in every spot, just as I would not commit myself that any particular camera was THE ONE for all press work. Under certain conditions, though, pigeons are wonderful assets for some papers or picture services.

MAKING THE DEADLINE

Pigeons are particularly useful for picture newspapers (tabloids or papers with much picture space) with many editions a day. With fewer editions, there will really be no great need for the speedy film delivery that pigeons assure. Although pigeons fly in races of many hundreds of miles, for newspaper work they are not practical for distances of over fifty miles on land. The U. S. Army uses fifty miles as their usual maximum flight, too. With modern portable wire-photo machines, you can beat a pigeon with a picture from distances greater than this. And it is obvious that for very short distances there is no great advantage. Where minutes count in making deadlines, and the photographer is in some far corner of a metropolitan city or its suburbs, pigeons are ideal.

A discussion of the training of pigeons would be too wordy here, but suffice it to say that carrier pigeons are generally trained to return to one point always, and that once deciding to use pigeons, you must establish a loft and start training young birds from this location. The ideal place for a loft is the roof of your own building if that is at all possible. In fact, several newspapers within my experience were unsuccessful in obtaining the full benefit of carrier pigeon service because their lofts were merely in the community; the human element in delivering films, even a few city blocks, may eventually discourage the success of the system. One newspaper that uses pigeons with considerable success not only has its loft on the roof of the building, but has installed a cable running down the side of the building, so that as pigeons return with film, the small containers of film may be clipped to the cable and the film dropped to the ledge of a darkroom window! Dropping the films eighteen stories saves a few minutes waiting for an elevator! It might be well to add that a full time caretaker for the birds is a distinct advantage if you contemplate regular usage of them.

Besides special event news coverage, I have seen pigeons used successfully in daily routine work as couriers from courtrooms to the office, for the man covering the suburbs

THE COMPLETE PHOTOGRAPHER



ATTACHING THE TUBE. When the film tube is taken from the pigeon, it is sent downstairs on a wire cable. This saves the time needed for an elevator trip—often making the scoop possible
Photo, Bernard Hoffman

beat (eliminates special messengers, meeting trains, etc.), and for use on news coverage at the far end of town. Some towns get daily sports coverage an edition earlier than usual because pigeons are used. It is wise to have so many birds that no one will have to work



GOING DOWN. After a 18-floor drop, the film tube reaches the darkroom floor, is taken off the wire and developed immediately
Photo, Bernard Hoffman

more than three or four times a week, although daily workouts won't hurt. Twice a day workouts in emergencies are permissible, though not recommended, for the birds must not be overworked. A good newspaper will have thirty to forty birds at a time including those used solely for breeding.

A photographer concentrating on pigeon pictures should not be expected to cover other angles, too, such as features or additional coverage. Pigeons are for *spot news*. If the event is important enough to warrant



CARRYING BASKET. When full, this basket holds eight or more birds. The small door on top allows one bird to be taken out at a time; the snaps on the side panel allow for opening to facilitate cleaning
Photo, Bernard Hoffman

other pictures, another photographer should be assigned. In fact, I can't recommend strongly enough the advantage of a boy to help carry the pigeons or part of your equipment when working parades or wherever live birds have to be carried through crowds.

EQUIPMENT

Most practical containers for pigeons on assignments are small carrying baskets. Particularly recommended are those with solid bottom and grilled top, with sides of canvas; the whole collapsing when empty by unfastening hinged vertical braces. Small ones carrying four to six birds are handy for assignments on foot, or to take birds into buildings. The larger baskets will hold as

CARRIER PIGEONS FOR NEWSPAPER PHOTOGRAPHY

many as 16 birds. Often these larger baskets can be fitted into the back or trunk of the photographer's car. One word of caution, however: be sure the trunk or car back is well ventilated so that no exhaust fumes can reach the birds!

FILM

The camera for pigeon work should be small—or at least should use small film. The U. S. Army uses larger birds and yet uses 9 x 12cm as their largest film size. Using a large camera and cutting down the film size is sometimes done, but you will find it impractical. 35mm cameras may be used if they are suitable for press work—that is if small sections of film can be removed easily and quickly, and if they are suited to flash photography. I recommend a slightly larger

size film. Although any camera using 2 $\frac{1}{4}$ x 3 $\frac{1}{4}$ -inch cut-sheet film or packs can be used, I have found that the Miniature Speed Graphic is ideal; inasmuch as it is identical with the regular press size, it has every versatility and feature, and a few advantages besides.

Now, film packs use thin film which is light in weight, but cut-sheet film is heavy and also will not roll easily to be put into the tube used on the pigeon. I have found that with a small cutting board in the dark-room I could cut 2 $\frac{1}{4}$ x 3 $\frac{1}{4}$ sections from roll film of the B2 or 120 size very easily and rapidly, particularly if the cutting board has an edge guide or thumbtack for a marker to help get the size accurate. Although this film will have some curl, you will find that the small size cut-sheet film holders have



IN FLIGHT. After an exercise flight, the young pigeons return to their loft on the newspaper office's roof. The training of the pigeons is, of course, most important. But that's not the photographer's job!

Photo, Bernard Hoffman

such fine rabbits (edges that hold film down) running around the inside that your film will be held very flat. I have tried hanging rolls of film in the dark for a day or so and also have put cut pieces under pressure in an attempt to straighten them out, but find that with a holder, particularly of the Miniature Speed Graphic type, the film is held very flat anyway.

For fast press work, Agfa Superpan Press and Eastman Super XX are available, and for a fast ortho film (many newspaper photographers like ortho films for flash work) try Agfa Super Plenachrome in roll-

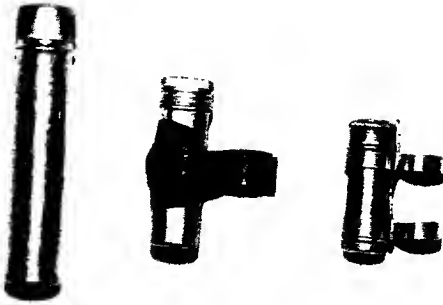
finished prints what the size of the negative was the processing is so good.

FILM TUBES

A little discussion here on tubes is necessary. I have experimented with metal, celluloid, and plastic tubes and I am convinced that aluminum tubes are best unless you can have special celluloid tubes made for you. The carrying tube must be lightweight, easy to load and unload, small enough to be carried easily by a pigeon, strong enough to withstand handling, and must be light-tight. The standard message capsule used by the U. S. Army and some pigeon fanciers is a small tube .2mm in thickness and 27mm long with an outside diameter of 9.5mm. Into this slips a slightly smaller tube (mouth to mouth) and the two are kept together through friction and pressure of the soft aluminum. This tube is too small for satisfactory work, even with 35mm film, and has a faulty device for fastening onto the pigeons' leg.

The next size tube is a large message tube 36mm long uncapped, but of extremely thin metal—.08mm in thickness. This tube is 11mm in diameter outside, which means that it can carry 35mm film and you can load five to eight frames into it easily. It has a fine Swedish spring-steel clip for fastening to the bird's leg, although a bit of black photographic scotch tape over the spot where the clip is fastened to the tube will insure its being light-proof. This tube has a small screw cap and is recommended for 35mm film.

The most satisfactory film capsule of all that I have seen for larger size film is a tube of .1mm hard aluminum, thinner metal than the Army tube, but much stronger. This tube is 61mm long and 12.5mm in diameter. This is large enough, I have found, to take four pieces of $2\frac{1}{4} \times 3\frac{1}{4}$ film of the special thin stock mentioned earlier in this article. This tube has a slip-on cap, because a threaded cap and top would greatly increase the cost and would take some of the strength which the present beaded rim has. All of these tubes are fairly reasonable in cost. The top of the larger tube, then, is made secure with a short piece of black photographic scotch tape. In fact, I have made it



FILM TUBES. These are the three tubes referred to in the article. The long one is recommended for 2-1 4 x 3-1 4 film and it will hold four negatives. The center tube is for 35mm film, while the other is the standard message tube used for captions
Photo, David Eisendroth, Jr.

While on films—a note about developing: this film size has an area a little greater than one third of a 4 x 5 inch negative. Often an area smaller than this is enlarged in general press work, so if the photographer makes a point of filling his negative as much as possible, there will be no need for fooling with long developing time, special fine grain developers. Regular press developers today are fine-grained enough for general pigeon work. Standard developing clips and hangers are available that will handle these films. With sufficient hardener in your hypo, wet printing of negatives will be as easy as it is essential. There is no need, then, to have a special darkroom for pigeon work since a little care in handling will yield good results. One paper is using a $3\frac{1}{2}$ to 4 minute developer and it's hard to tell from the

CARRIER PIGEONS FOR NEWSPAPER PHOTOGRAPHY

a practice always to use tape on the tops of all tubes to prevent possible loss or opening due to vibration or strain.

PACKING THE FILM

It is very wise to wrap all films in black paper before inserting into the tubes; this prevents scratching of films, possible fogging, and makes insertion and removal of the film from the tube much easier. Film insert papers are fine for this.

The $2\frac{1}{4} \times 3\frac{1}{4}$ size film is removed from the holder and each piece carefully placed one on top of another and then rolled tightly—but be careful of “cinching.” A little practice will help. The rolled up film is then placed on a sheet of black paper diagonally and rolled from corner to corner of the paper. This will give you a little point of black paper at each end to be tucked inside the roll of film and will aid the darkroom men in removing the film from the tubes. Up to four pieces can be sent. All of the loading in the field, of course, is done in a changing bag or changing box. Filmpacks are handled just like cut-sheet film, of course.

With 35mm film, you will have to be careful not to shoot more than the five or six pictures which you can load into your tube. Sometimes, when something big happens when you have just made five or six pictures, you may have to sacrifice the first picture to make another. This is one disadvantage of a 35mm camera for spot news work; sometimes having two cameras is helpful. I usually shoot my pictures on 35mm film and then leave a blank on the end for handling before cutting the film out of the camera. With a Contax you shoot one frame extra for this “handling piece” and in the changing bag, with a small pair of scissors, cut the film just to the right of the curtain. With a Leica, shoot two extra frames and use the special knife made for the purpose of cutting the strip of film out of the camera. The knife goes right down the back of the camera next to the take-up spool. You can work out your own system with other cameras.

A good thing to remember when measuring 35mm film in a changing bag is this: you will have several inches of leader which you don't need to send in the capsule—so knowing that each frame is an inch and a half

long, you can sort of measure off along your thumb. With a little practice in daylight at first, you will be able to measure off five or six frames (don't forget to add an extra one on each end for handling in the darkroom) and cut them off with your scissors. Tearing is all right but sometimes you will not tear evenly and this makes the film hard to roll. Rolling 35mm film is very difficult and takes much practice; start your roll small and keep rolling tightly—but beware of “cinching.” The best stunt I ever saw for rolling this film was a small key with a forked or grooved end—like a sardine can key with an open end. With this key you can get a good grip on the end of the film and roll the film tightly around the key; the key is slid out with a slight twist when you have finished. This film, too, should be wrapped in black paper, both as a safeguard and to facilitate removal of the film from the tube in the darkroom. Be sure to wrap the paper tightly and smoothly and to tuck the ends in.

FASTENING THE TUBE

After you have inserted the film into the tube you are now ready to put the tube onto the pigeon. Various harnesses have been made for attaching tubes to a bird's back. In my experience I have never seen one that was wholly satisfactory, although the U. S. Army is experimenting with light celluloid tubes and elastic harnesses. I suggest, therefore, that leg tubes be used.

There are several methods of fastening tubes to a bird's leg. The most satisfactory method I have found is a small steel clip-spring in the shape of a figure eight. The tube slips into the bottom half of the eight which is slightly larger than the diameter of the tube and is riveted to the side of the tube with a small aluminum rivet. Care must be taken to make this point light-tight. The top half of the clip is split at the very top of the “eight” so that when the sides of the bottom are pressed, the upper part will open; when released, the upper part springs closed. With a little care, such a clip will last for a long time, and can be fastened to the bird in a jiffy. And sometimes seconds count when action is happening and you want to send off early stuff for an edition.



TUBE IN POSITION. The small 35mm tube is shown as it is fastened to the pigeon's leg. Notice that the clip is above the leg band
Photo, Bernard Hoffman

A good substitute for a clip, and one to remember in an emergency, is a small "prepared bandage"—one of those little things that come with adhesive tape and gauze in the middle. Always fasten tubes above the band on the bird's leg, and with a long tube, be sure that the tube is so high that the bird won't step on the bottom end of it. This is very important even if the clip or tape or other fastener has to be placed off center and toward the bottom. The bird must be comfortable or he may try to kick the tube off or refuse to come in.

HANDLING THE PIGEONS

Your handler can show you how to manage pigeons. They are easily handled by holding the legs between two fingers with the thumb crossing over the back to hold the wings down. Turn the bird upside down and you will find the two legs will be popping right up at you—easy to fasten a tube to one of them with your free hand. When releas-

ing birds, just let them fly free, being careful that they have a clear open space to fly into to get their bearings. Be careful of low hanging wires and branches. I have made a habit of always releasing two birds at a time even if one carries nothing. This helps to insure safe and speedy arrival and will encourage faster service. More important than utmost speed, however is *reliability*.

GENERAL PROCEDURE

It is an excellent idea to phone your office as soon as the birds are released, whenever possible. The picture desk will then know they may expect pictures and plan on space for them. You may send captions on another bird, or stuck into the film tube, although phoning is faster because the birds will be on the way while you



HOME AGAIN. When pigeons are released at a baseball park or other news location, they fly home. As this pigeon goes through the bars of his loft, a bell will ring to notify the attendant of his arrival
Photo, Bernard Hoffman

CARTE DE VISITE

are giving them. I strongly recommend that you keep a notebook of flights; that you make a record of each bird that flies, what time he left, what distance, what wind, what weather, what bird he flew with, and what time he arrived. Such data will be invaluable in planning your release times when you have editions to make on hot stories.

I keep a small notebook right in my changing bag. Also in the bag I carry a small box which holds tubes, the end of the box has a clip holding already-cut pieces of black paper, and on a small piece of metal I have a few dozen pieces of black photographic scotch tape about two inches long and ready to use to seal tubes; also bandages for emergency clips, a pair of scissors, a knife for cutting film from a Leica, and a key for rolling 35mm film. I also carry a pad of thin tissue paper for captions or notes to send with the film.

At first pigeons will be an experiment for you. You will have to organize your pigeon service. You will have to convince your picture desk that you can and will scoop rival papers and that pigeon pictures should be used *immediately*, since your rivals will not get pictures into their offices as soon as you. After a while the novelty will wear off, you'll no longer use the pigeons as a "stunt" but as a serious and reliable method of getting pictures to your darkroom many minutes sooner than your rivals.

CARTE DE VISITE. After the invention of photography, it was for some decades the vogue to have a daguerreotype portrait taken. These portraits, however, were somewhat expensive and, of course, limited to only the one "copy." When the wet plate process was invented, photographs could be duplicated, could be made cheaply. Portraits were within the budget of everyone. In about 1857, the cartes de visite appeared—the first mass-production products of the wet plate process.

The carte de visite (or card photograph) was an inexpensive portrait which was pasted on a card of from $2\frac{1}{2} \times 4$ to 2×3 inches and used as a calling card. This type of portrait is said to have originated in Paris, in the studio of Disderi. When introduced into America a few years later, carte



ANDRÉ-ADOLPHE-EUGÈNE DISDERI. This is a self portrait of the Parisian photographer who popularized the carte de visite. Disderi, court photographer to Napoleon III, patented the carte de visite photograph in 1854 and operated a huge studio in Paris to take portraits of France's great and near-great. Notice the costume, the pose, and the properties
From the Barthelemy Collection; Lent by The Museum of Modern Art

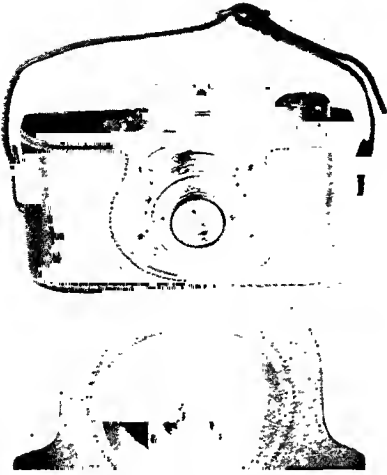
de visite portraits could be had for as little as 10 or 15 for \$1.00. They flooded the card baskets of friends and, eventually, found their way into the traditional family album. The vogue for cartes de visite lasted for 10 years or so.

Cartes de visite usually depicted a standing figure held rigid by a head brace posing before a painted background and grasping a column base or chair back. A wet collodion plate was used for the exposure—which ranged from 3 to 30 seconds. Many photographers used a 4-lens camera and shot four exposures at a time. This meant that the plates were large, the separate negatives small. Prints were made on specially

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sized albumen paper, a printing out paper which was exposed in sunlight. A final gold chloride toning gave them their familiar brownish look.

CASES FOR CAMERAS AND ACCESSORIES. Protective carrying cases for cameras and accessories are among the photographer's most valuable possessions. Common sense demands that protection should be given to precision instruments. Knocks



ARGUS EVEREADY CASE. For the miniature camera, most eveready cases are of this design. Here the Argus A2 is shown ready for action, with all the essential adjustments uncovered

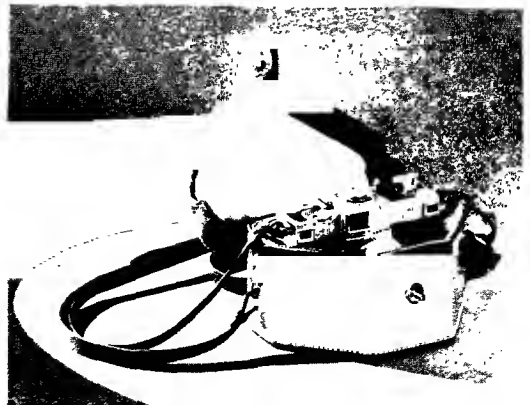
and jars, falls, dirt, sand, water—all these can mean disaster to fine equipment.

Cases are designed, today, not only to afford this protection, but also to make carrying and use easy. And you will find cases for cameras, lenses, filters, tripods, exposure meters, flash equipment, finders. The main considerations are materials and construction. In other words, although cases come in soft suede, fabric, cardboard, and soft leather, the hard leather and rigid construction is best for sensitive instruments. Cases come, too, in the "purse" type, but the ideal is the eveready case, where a few adjustments will lower a portion of the case, leaving the instrument still attached but workable.



PURSE CASE. This soft leather zip-top case is carried in the hand and the camera is taken completely out when in use. Such cases are inexpensive but do not give the complete protection that a hard leather case would give. This one, made by Kodak, comes also with a long neck strap

Camera Cases. More and more cameras of today have special cases which are available as accessories. Other cameras can easily slip into the regular purse-type zipper top cases which come in various sizes. In the typical eveready case the camera is secured by means of a bottom screw (this screw almost always is the tripod screw adapter) and is ready for use when a front flap is unsnapped or unzipped. Cameras having these special hard leather eveready cases are: Contax, Argus, Leica, Argoflex, Agfa Viking and Readyset, Ektra, Korelle Reflex Foth Derby, Welti and Weltini, Dolly, Agfa Memo, Speedex, and Clipper, Kodak Bantams and 35, Vigilant, and Monitor. This kind of case is by far the



KODAK EKTRA CARRYING CASE. Slightly different from the usual case, the camera and case are both attached to one neck strap. When in use, the camera is out of the case. Notice the extra room at each side of the lens—for film, filters, or other small items

CASES FOR CAMERAS AND ACCESSORIES

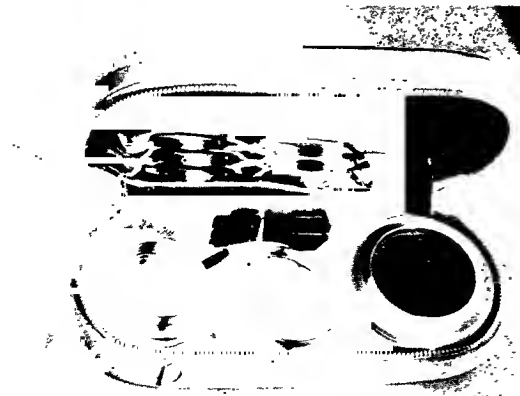
best—and most expensive—since ease of operation is at a maximum and the chance of dropping and causing other damage at a minimum. Besides the dropping front



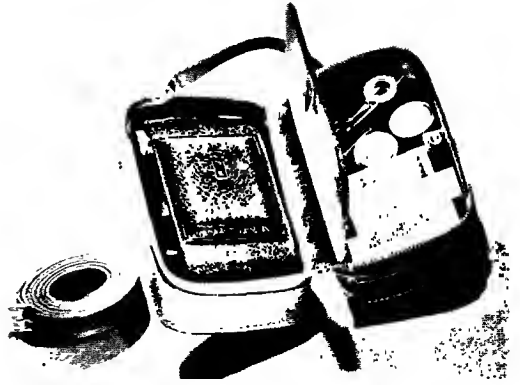
LEICA FILTER CASE. It is always good to have as few separate items as possible and, while it is not advisable to load the camera with accessory cases, this filter case is very handy. It is light and thin, holding 2 filters and lens tissue, and snaps on to the camera case at the bases of the neck strap.

flap, the case should have an adjustable strap. And such essentials as tripod socket, film winder, and counter should be accessible—even if a hole must be cut into the case.

Other camera cases are of the snap or zip-top purse type. These must be slipped off before making a picture and, if not attached to the camera in some way, are apt to interfere with the ease of operation. They are inexpensive, however, and give adequate protection when the camera is not in use.



FILTER CASE. This handy hard leather case holds six small filters and a Polo-Screen, two adapters—the slip-on and screw-on type—and a lens shade. With a zipper opening and a soft lining, these camera accessories are safe. Made by Kodak.



DUPLEX CASE. Something very handy in the way of cases is this two-sided hard leather one. The one side holds a Kodak Six-20 or smaller model, while the other accommodates film, portrait attachments, range finder, filter, and other accessories. Notice, too, the soft cloth lining and the extra neck strap.

Special camera cases are made for view and press cameras. These are box-like in construction, extremely sturdy though cumbersome, and hold a few accessories. For a film pack, plate, or cut-sheet film camera, a place for extra film is essential. Also, for the views and studios, where lenses are often interchanged, space must be made for lens equipment. And something new in camera cases is the one made for the Kodak Ektra. It is designed to hold the camera with a 50mm or 35mm lens and it is equipped with a double-ended neck strap. One end is attached to the camera and one to the case, thus eliminating all danger of dropping.

Accessory Cases and Gadget Bags. All fragile accessories should have their proper cases. Kalart, for instance, puts out a blue suede bag for its synchroflash equipment; many tripods come with carrying cases looking a good deal like gun carrying cases. Filters, being as damageable as lenses, should have proper carrying cases—and among the handiest is the Leica three-filter case which is attachable to the camera case and which holds lens tissues as well. And lenses, of course must be treated with the utmost care. Hard leather cases are essential and the metal cases, such as those provided by Ektra, are better. *Every extra lens should have its case.*

Other accessories come with cases. Leica, for instance, provides cases for its range finders, view finders, self timing devices, and

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negative viewers. Contax, in addition, has leather carrying cases for various lenses plus filter, lens hood, and finder; it also has a case for its Universal Stand and accessories. But among the most important of the equipment cases is the light meter case. If the meter is of the photoelectric type, it is *extremely* sensitive and can be hurt by knocks and jolts—and also by excessive light when not in use.

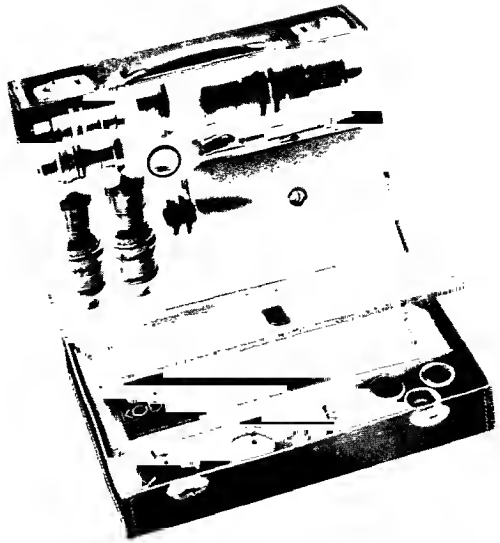
With all these accessory cases, it is a good idea either to attach the instruments to the camera strap or to have separate straps. But even this sort of thing can go too far



GADGET BAG. This is the top in gadget bags, being made of excellent leather and having plenty of room for almost anything. The four snap compartments are for filters, the zipper compartment in the top may be used for notes or other flat material. Both the outside and main compartments are lockable. Shown here is a 4-lens Filmo motion picture camera with extra film, lenses, and accessories. But it is equally useful for any still equipment. Sold by Morgan Comerio Shop, Hollywood, California



FILMO CASE. For the motion picture photographer who does not want to carry around extra lenses and many accessories but who wants good protection for his camera, this case is built. It is the hard leather purse type of case—simple and inexpensive. Shown with it is the Bell & Howell Auto Load Speedster



COMPARTMENT CASE. This is typical of the fitted cases—as distinguished from the loose gadget bag. It is specifically built to hold a 16mm Magozine Cine-Kodak, its extra lenses, filters, shades, and film. If a motion picture photographer expects to own and carry more than the bare essentials in equipment, a carrying case is recommended

and the sight of an overloaded “gadgeteer” is familiar to many people. A good solution, in this case, is to get an accessory or gadget bag. These come in hard leather sometimes, more often in soft leather, and almost always with a zip top and shoulder strap. Some cameras—such as the Contax, Leica, Ektra, Korelle Reflex, or Super Ikonta B—come with special fitted cases, where the space is planned and allotted to important equipment. This is, of course, the best kind of accessory case, as there is almost no chance of pieces of equipment jarring each other within the bag. Many cameras, however, do not have specially-made fitted cases, in which case the gadget bag is the thing.

Movie Camera Cases. Satisfactory motion picture carrying cases are those which carry the camera, film, lenses, filters, meter, etc. There are available for practically all movie cameras. A rather new concept in movie camera cases is the ready-rest or candid case, resembling the eveready still camera case. With a movie camera, the top, front, and both sides must be uncovered. These cases are attached at the bottom only and can be slipped into operating position with a hinge-like action.

CAT PHOTOGRAPHY

CAT PHOTOGRAPHY

Rudi Rada

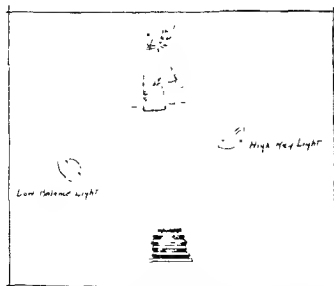
*Woodmere Darkroom, Long Island, Specialist in
Cat and Child Photography*

One of the hordest domestic animals to photograph is the cat—and for that reason cat photography is an interesting challenge to the photographer. Here Mr. Rado, a specialist in cat and child pictures (he finds them similar photographic problems), explains his formula of "Patience, Catnip, and Cream."

See Also Animal Photography, Dog Photography

CATS AND KITTENS are photographic naturalists. Children are the only subjects which steal the show from them. The problems arising in photographing both children and cats are in many cases quite similar. They are personality models. Naturalness and charm predominate. They are always themselves. The pictures will be sure to have an appealing quality all their own.

Kittens like children are unpredictable and have an irresistible charm. Cats, on the other hand, are self-absorbed, secretive, moody creatures. Undomesticated domestics, they are individualists possessing their own definite, set habits. Each cat to be photographed is a separate character study.



Cats do not pose but their actions may be conditioned. They are completely still only when asleep. Paradoxically every position is a pose. Their inherent grace and beauty of line is photogenic from any angle. It is quite simple to take a really good cat or kitten photograph. Just picture this; the serene austerity of the older cat, its aloof independence and its condescension. To all this add the quality of texture. The result is bound to be gratifying. It is impossible not to have fun and satisfaction in successfully conquering the problem of the better cat picture.

Cat photography is a constant paradox: a paradox of plan plus accident. The best results are obtained by arriving at a medium of plan and happy accident. Before begin-



CURIOSITY. The diagram shows how, with careful lighting, this cat photograph was taken to appear as if illuminated by soft candle light. The key light was placed high, above the subject, the camera was at subject level, and the balance light below the subject. DATA: fast pan film, 1/50 second, f/4.5, candle given 8 seconds of additional exposure

Photo and Diagram, Rudi Rada



PUKO. An extremely appealing shot of a kitten, this one was carefully planned. Puko was picked up gently and then dropped from about 1 foot onto the soft bed. This startled expression was caught by synchroflash
Photo, Roton

ning to photograph, a basic idea must be formulated. After that, the general composition of the picture must be definitely planned. When the basic idea and the general composition are set, the accident of form and expression of the animal added to it create the complete photograph.

PATIENCE, CATNIP, AND CREAM

Patience is, without a doubt, the prime requisite. It must be the one constant factor.

Catnip and *Cream* are conditioning elements. These are most useful if properly handled. Everyone is familiar with the action of cats under the influence of catnip. At the very smell of it they become animated and playful. For an alert pose use catnip. Both catnip or cream may be used to lure

and keep a cat at a given spot. For a fixed pose use cream.

This method was successfully used in the taking of the picture, "Curiosity." The basic idea was to have the kitten looking into the flame. Some preparation was required to create this illusion. The result could, possibly, have been obtained by double exposure, but the cat would have lost its natural charm. The candle, a very large one, was coated from top to bottom with cream on the far side of the candle away from the camera. The kitten naturally started to lick the cream at the bottom of the candle. Each time he licked it, more cream was applied to the candle. But the application was gradually directed toward the top of the candle, thus drawing the cat's attention upward. Finally, only the top portion of the candle had cream on it. To reach the cream, he had to stand up on his hind legs. This was the picture!

EXPRESSIONS

Expression in cats and kittens is the sum of two elements: *eyes* and *body form*. Eyes are the more important factor of this combination. Here the conditioning of light is used. For an alert, amazed, or frightened expression, both eye and iris must be round in form. This may be obtained only with flash. The flash is of such speed that the iris has no time to contract. For a relaxed expression the eyes and iris should have an elongated form. In this case flood lights are the ideal lighting.

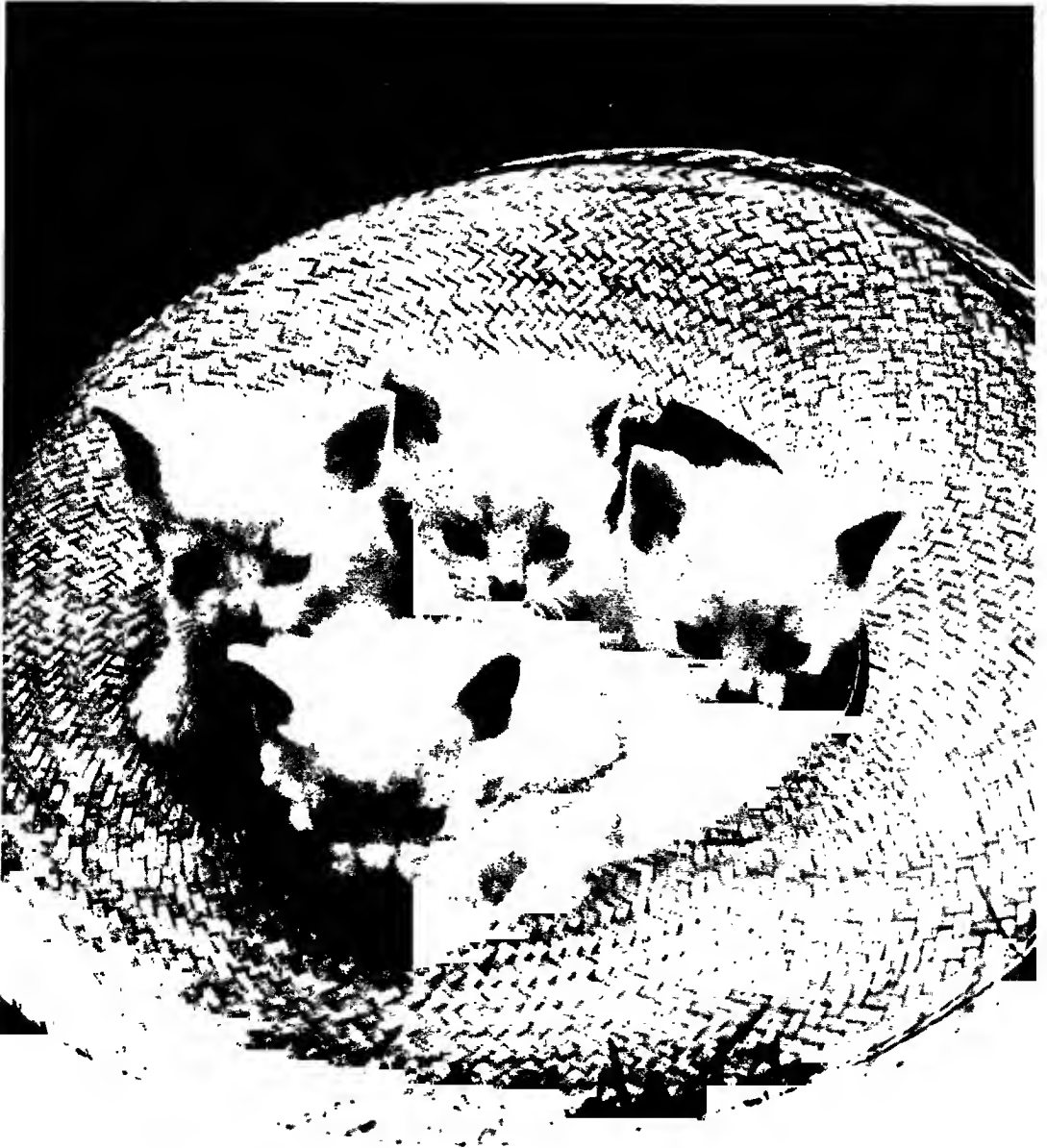
Body form is usually an accident. Patience and watchful waiting for the animal to assume the required pose is the only solution. But with a little ingenuity, certain positions may be obtained. For example, a

CAT PHOTOGRAPHY

kitten may be made to sit up very straight by picking it up gently and then dropping it a foot or two onto any soft surface. The animal will then brace itself against the softness to a stiff sitting position. If taken from a front angle with flash, this pose,

gives a startled look as in Rotan's "Puko." If dropped onto a hard surface, the cat or kitten will stand stiffly on all fours.

Any cat or kitten, if left under floodlights, will fall asleep from the heat of the bulbs, in either a sprawled or curled form. Then if a



HATFUL OF FLUFF. An easy way to photograph a group of kittens is to confine them in some space that is within camera range. This hat did the trick and made a good setting, as the stiff straw sets off the fluffy fur very well. Cats are difficult to photograph outdoors, but kittens, not so agile, are easily controlled
Photo, J. C. Allen and Son

THE COMPLETE PHOTOGRAPHER

sound is produced by tapping a coin or key on the reflector, the animal will momentarily open its eyes and turn in the direction of the sound. The position of body form will still be relaxed. These moments must be patiently awaited and taken advantage of instantly when they do finally occur.

TECHNIC

The natural curiosity of the kitten may also be used to advantage.

An understanding assistant, preferably the owner of the animal, or someone who likes cats, is of great help.

Because the cat as a household pet becomes so much a part of its home surroundings, stress has been put on the photography of the cat under artificial lights indoors. Outdoor pictures of the cat are, in most instances, more of a problem. It is difficult to confine the animal to a definite area—the exception being the cat lying asleep in the sun.

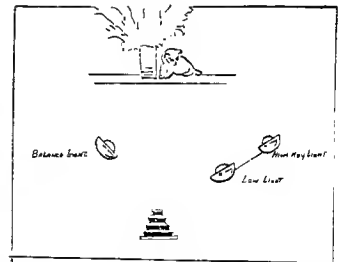
The actual technic in photographing cats presents certain problems.

(Continued on page following insert)



KITTEN AND VASE. This shows the use of 45° angle lighting, with high and low key lights and a balance light. The kitten has been caught here while playing with some berries which have dropped from the vase. A carefully executed and interesting composition. DATA: fast pan film, 1/50 second, f/8

Photo and Diagram, Rudi Rada



COMPOSITION ANALYSIS for . . . RAYMOND GRAM SWING

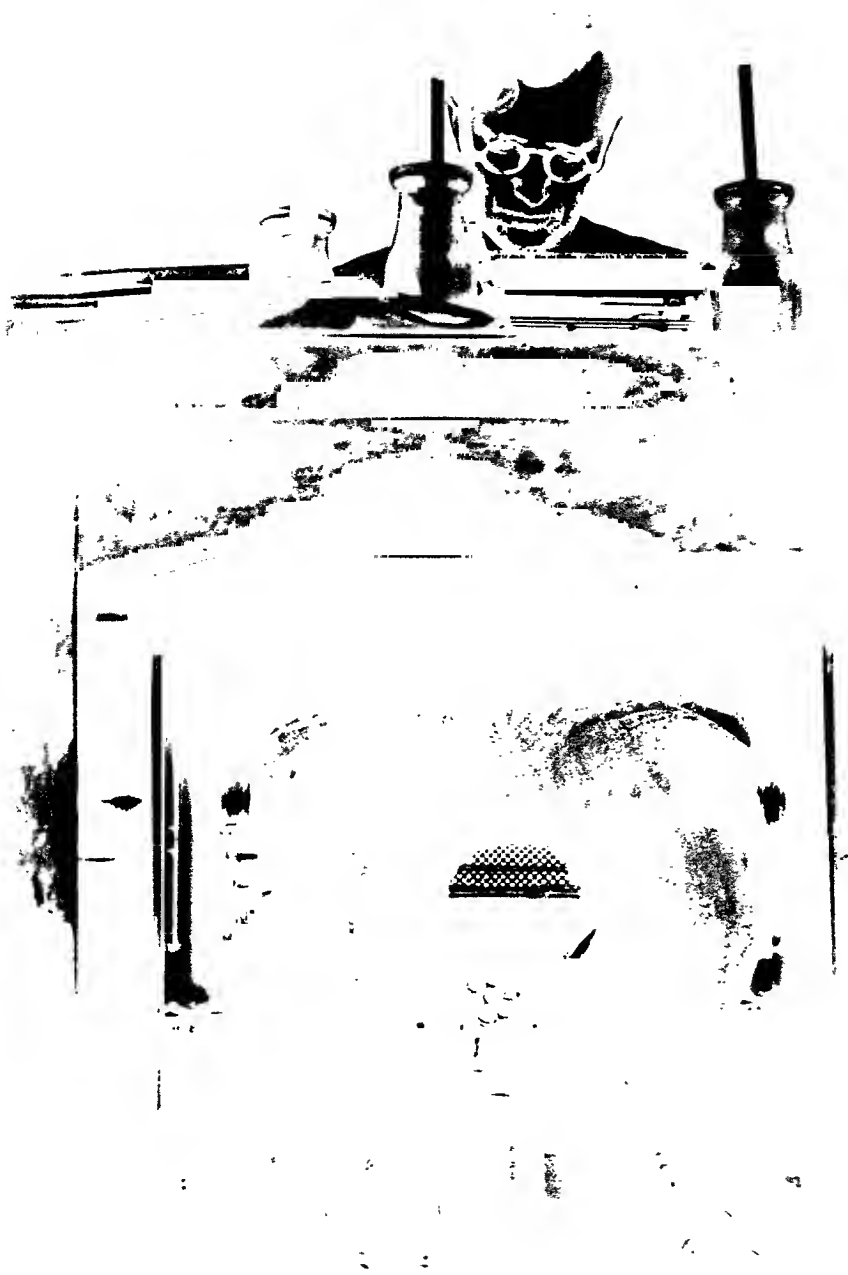
This daring picture violates all sorts of rules: "Never cut your picture in half,"—"Never take a portrait from a straight frontal position,"—"Keep away from straight lines if you want a dynamic effect,"—"Don't miss the hands, they are an important part of a person's character,"—and a dozen others relating to such principles as lighting, composition, and balance. This picture ignores most of them, and yet, it achieves a profound effect. Why?

The picture is bursting with contrasts, and it is these strangely piled and unusually arranged contrasts that keep your eyes glued to the picture, puzzled and yet satisfied. The contrasts are structural and mental.

As to the structural, the mass of black and gray and "dead" matter outweighs the light and human matter by at least two to one. The other powerful contrast is furnished by an upward-downward opposition, with the shoes, the legs, the chair, the desk and, finally, the milk bottles forming a strong vertical theme opposed by but a single downward trend: the face.

On the mental side we have the tense lines of the face telling of the exhaustive struggle of concentration in contrast to the heavily seated man. All in all, a masterful composition.

Gerhard Hirschfeld



RAYMOND GRAM SWING

See article on Candid Photography

ERICH KASTAN



FRENCH RIVIERA

LISETTE MODEL

Lisette Model is a French photographer who came to America in 1940. She brought with her many documentary photographs such as this one, showing France on the eve of its fall. An excellent candid photograph, it is thought by many to be symbolic of the pre-war "Riviera attitude." See article on Candid Photography. DATA: Rolleiflex, fast pan film, 1/100 second, f/8



SMOKY

KENNETH MARSH

Cats are difficult to photograph not only because they are often quick and restless, but also because their characteristics are hard to capture in black and white. Here the photographer has chosen the eyes as the main point of interest. It is a straightforward portrait and a good one. See article on Cat Photography. DATA: Korelle-Reflex camera, Proxar lens, slow pan film, 1/25 second, f/5.6, 3 photoflood lamps, Agfa 17 film developer



HELLO, AMERICA!

FRANK GEBMAN

These two little British refugees were photographed while gazing through a hawser hole—their first glimpse of America. As a human interest photo it is good, but as a news photo, symbolic of the thousands who are seeking refuge from war torn Europe in this country, it is excellent. More and more of such interpretative and well-taken pictures are finding their way into the nation's newspapers and picture magazines. See article on Camera Journalism

Photo, Acme Roto Service

CAT PHOTOGRAPHY

(Continued from page preceding insert)

The first step in the taking of any cat or kitten picture is the restriction of the area in which the animal may move. A familiar spot should be chosen which naturally confines it: a mantle, a table top, hassock, favorite chair, pillow, or rug. This simplifies focusing and gives a definite depth of field. Focus on the important point in the composition. If necessary, place the cat for a short time at this point and focus. No thought need be given the animal itself until the time picture is actually taken. The aperture is cut down to cover the depth of field which should correspond to the restricted area. Therefore sharpness is maintained even if the cat moves. Naturally, the shutter speed must be fast enough to stop whatever action occurs. It will be found that under artificial light such as flood lighting, an aperture at about f 8 will cover the required area. When set, apply cat to spot and apply to cat "Patience, Catnip, and Cream."

Shutter Speeds. Extremely fast shutter speeds need only be used in two cases: *outdoors*, where cats are naturally restless and have to be caught in action; *indoors*, when movements of play are being photographed. Action indoors must be photographed with synchronized flash. Shutter speeds must be 1/200 second or more.

Indoor photographs taken with flood lights can be taken at 1/50 or 1/100 second. Cats are more relaxed under the heat of the floodlight. Therefore sudden movement is less likely.

Exposure should be full because fur texture is important. Cat and kitten pictures must have a *furry* feeling. Fast panchromatic films are recommended. These allow the photographer to work at higher shutter speeds and are at the same time softer in quality.

Lighting Three types of lighting are at the command of the photographer: sunlight, flash and artificial flood lighting.



CAUGHT IN THE ACT. Cats and kittens are often so quick that a flash is needed for candid shots of action. This, however, was gotten with a miniature and natural light from a nearby window
Photo, C. D. Notley

THE COMPLETE PHOTOGRAPHER

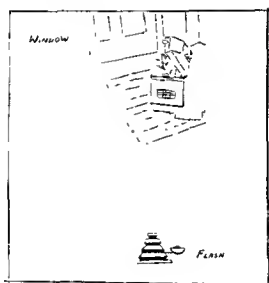
Sunlight needs little explanation. Bright sunlight is best. Hazy or dull sunlight tends to flatten textural quality.

Flash is best used in synchronization. It is most important in the taking of action photographs, but it also has other useful functions. First it produces the aforementioned roundness in eye and iris for certain expressions. It is best to use multiple flash in such instances. Balance the lighting by using one flash bulb on the camera, another on a long extension. The extension light may be used on a tripod. This gives a lighting equivalent to floodlighting but a difference of expression is obtained. Second, it is excellent as a balance, fill-in, or supplementary light to sunlight either in or out of doors. Most effective usage is to take a strongly backlit subject and alleviate the shadow area by shooting into it with flash. This is synchro-sun photography.

Floodlighting, if properly handled, is the most effective lighting medium of the three types. Sunlight effects can be

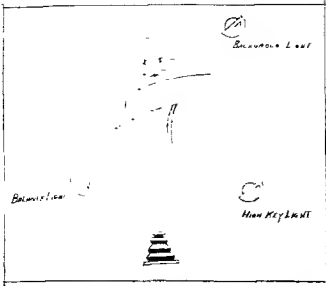
made. A textural quality is achieved which no other lighting can equal. Softness and a dimensional quality can be given because of the complete control of the light. Background effects may be heightened. The little control that one has over the animal is most easily attained because cats are more quiet under floods than any other type of light. The 45° angle lighting and its modified forms are best suited for planned cat pictures. The lighting should be balanced to give the feeling of daylight.

Backgrounds. Simple backgrounds are best. If a light background is required, it is best lit separately with the flood or spotlight. If photographing in a home where there is no plain, unfigured wall, throw the background out of focus. The completely void, dark background is easily obtained by using a long strip of heavy black, dull-surfaced paper two or three feet in width. Put this on a table, desk or floor, and bend upward in a long flat curve. Light gradually fades from the dark surface.



EFFECT OF FLASH LIGHTING. The photograph on the left shows a kitten in its carrying case—taken only with natural backlighting. While this is a good shot, the one shown at the right is an improvement. Here, as shown in the accompanying diagram, synchroflash lighting filled in the shadows and gave added detail. It was taken on fast pan film at 1/200 second, f 11, with 1 Press 40 flashbulb
Photos and Diagram, Rudi Rada

CAT PHOTOGRAPHY



When using flash be careful of backgrounds. The aperture is necessarily small and great depth of field results. This sharpens up backgrounds. Backgrounds easily become too busy and disturbing. They must be in keeping with the general idea of the picture and subdued in order to give the subject prominence.

EQUIPMENT

Cats may be photographed with any camera that has speeds to 1/100 second. Sleeping and relaxed poses may be taken with even simpler equipment. Reflex cameras with a fairly long focal length lens are best. Operation is quick. Focusing is accurate and the depth of field can be seen. The author usually uses a $3\frac{1}{4} \times 4\frac{1}{4}$ Graflex Camera with a $6\frac{1}{2}$ -inch lens. If a reflex camera with a short focal length lens is used, angle shots must be taken with caution. Too much distortion is liable to occur. This may, however, sometimes give a dramatic or strong result. In most cases it is unpleasant or unnatural. Any camera which can be synchronized may be used for action flash shots.

Above all equipment, however, the greatest quality needed to take successful cat pictures is patience and a sympathetic understanding of the animal. An alertness to every picture possibility is essential. One must be ready and quick to take advantage of the ever recurring accident of form made by the changing positions of the animal. When the accident conforms with the plan, the reward is worth all the effort.



READY FOR ACTION. When the lights had been placed as indicated by the diagram, the cat was put onto the hassock and a low light arranged to give a single catchlight to the eyes. The alert expression was caught with a high shutter speed. DATA: medium pan film, 1/100 second, f/8
Photo and Diagram, Rudi Rada

FILMS

Panchromatic high speed films such as Super-XX or Superpan Press are the best for general usage. The large majority of cats are colored: blue-grays, red-browns, tortoise-shells, etc. Pan films give truest long scale monochromatic rendition of these various colorings. The softness of the films give a better textural quality and the speeds are in most cases an essential.

No mention has yet been made of cats which are pure white, pure black or black and white. In these instances orthochromatic films produce the best results. Today orthochromatic films are also manufactured in high speeds, such as Super Ortho Press, etc. Therefore a high speed film is available that gives better detail and contrast where there is only black and white to consider.

Pure white cats are a separate problem—the most difficult to photograph properly. Soft evenly distributed light is necessary. Screened artificial light, whether flood or



GROUP PHOTOGRAPH. When photographing a group of cats or kittens, it is best to confine the group to a rather small space—in this case it was a table. These kittens were made to stay on the table top until completely tired or bored. Then they were startled by the sudden appearance of a dangling piece of paper. A dozen shots were then possible. Almost infinite patience produced this excellent group photograph. White cats are notoriously difficult to photograph—and here is a good picture of five of them

Photo, Thomas Fall

flash, or subdued daylight in combination with a slow ortho film of the Verichrome or Plenachrome type must be used to give full rendition. A high key picture of a white cat is a supreme achievement in fine photography.

GROUPS

The only photograph which is more charming than that of one kitten is a photograph of more than one kitten.

The important fundamental to remember is area restriction. Kittens are probably the world's most curious and most active creatures. If you have four or five to deal with, dig deeply into your fund of patience. Use a basket or box lined with some soft, dull-finished material. This restricts the kittens to a given area. Because of their curiosity and activeness they will try to

crawl out. Group pictures must be taken at high speeds, preferably with flash. Movements, at such times, are usually quicker than the photographer realizes. From a picture standpoint, baskets photograph better than boxes. The different varieties of reed weaving used in baskets make pleasing definite patterns in contrast to the round, soft, furry forms of the kittens.

Other interesting pictures result when shooting from a low angle at groups of kittens on a small table or desk top as they peer over the edge.

Feline family groups are pictorially possible, especially with Siamese cats. The Siamese are the most ancient of the breeds we know today and are most highly domesticated. The kittens grow more slowly and the mother is much more solicitous than any

CAT PHOTOGRAPHY

other type of cat. The male also takes an active interest in his family. Therefore, very fine possibilities present themselves in photographing cats and kittens together.

Adult animals of other types are very difficult to photograph together, except in set pairs.

SHOW CATS

Pedigreed cats must be shown to best advantage for show possibilities. The photographer should cooperate wholly with the owner or breeder. The owner will want certain features to predominate. In the Siamese, for instance, the blue or seal points of

the ears, paws, and tail must be clearly and well defined. In the Angora and Persian types, the richness and even coloring of the coat is important. If the owner wishes to show off strength of head and body, a slightly low angle front shot taken a little to the right or left is best.

But for show cat or alley cat, the technic is much the same. First, of course, you have to like cats—and they have to like you. And there never was a dumb cat—don't forget that. They are, for the most part, lively prima donnas, and for that reason they are always interesting to photograph.



BLACK PERSIAN. This pedigreed show cat has been most effectively photographed in low key. The cat's whiskers, nose, and ear have been given subdued lighting—and the eye is the absolute center of interest. The treatment shows understanding of this majestic animal. DATA: fast pan film, 1/100 second, f 4.5
Photo, Rudi Rada

CAVE PHOTOGRAPHY

C. E. Mohr

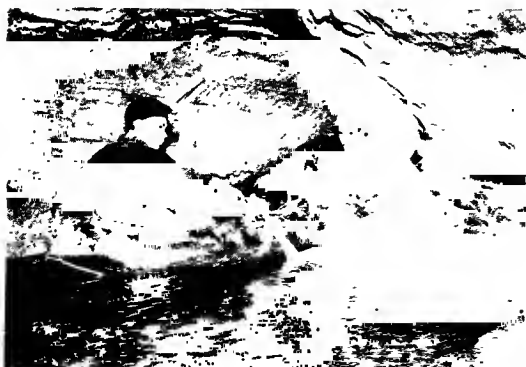
*Director of Education, Academy of Natural Sciences,
Philadelphia*

Cave photography offers adventures galore. How to explore and photograph a cave, how to picture bats, salamanders, crickets, and crayfish—such information is given. Mr. Mohr also tells about what camera to use, what illumination is necessary, what film and development are best.

See Also Animal Photography, Biological Photography, Cavern Photography

THE FIRST large colony of bats I ever saw, in Nickajack Cave, Tennessee, was on the far side of a subterranean river. On the bank was a dilapidated rowboat but it sank when I pushed it into the water, so I waded for 40 feet, with 50° water up to my armpits, my equipment in a basket on my shoulder, and my heart in my throat. Keeping my feet on the slippery stream bed while struggling against the strong current was an acrobatic feat which had to be repeated on the return from my successful mission.

The sight of row upon row of bats, covering the wall or ceiling of a cave like a great furry tapestry, is fascinating to any photographer. You won't always have to wade a chilling stream to reach them, but many times it is difficult, if not actually dangerous, to get the picture you want.



EXPLORING A CAVE. The cave photographer must always do his exploring with at least one companion—not only because he can be a help in handling equipment, etc., but also because of the safety factor. *It is never safe to go into any cave alone*
Photo, Arthur Palme



NEW ENGLAND CAVE BAT. The New England cave bat is sometimes called the flying mouse, and this shadowgraph silhouette shows clearly the mouse-like body. This bat was photographed when dead. It was laid on a piece of glass and lit from beneath
Photo, Arthur Palme

More than once I've had to brace my shoulders against one side of a "chimney," my feet against the opposite side, above a black chasm, calling "one, two, three . . ." for my companion to set off a flashbulb from behind a screening ledge to cast wierd shadows above the bats on the wall beyond me.

Exploring caves alone, by the way, is foolhardy. *Always take someone with you.* It's smart, too, for you to tell someone in the neighborhood that you are going to visit the cave, then inform them when you come out.

There are lots of adventures to be had underground. The bats you find in great festoons may be merely roosting, not hibernating. If startled, their sudden exodus may come close to suffocating you.

LOCATING CAVES

There are caves in southwestern New Mexico and western Texas where millions of bats burst forth at nightfall—looking from a distance like smoke pouring from the bowels of the earth. There are bat caves, too, in central Texas, southern Oklahoma, in Missouri, Kentucky, Tennessee, northern Alabama, and central Florida. Even Indiana, Pennsylvania, central New York, and a few spots in New England have some caves in which hundreds of bats hibernate. There are other caves in these states and in

CAVE PHOTOGRAPHY

South Dakota, Ohio, and Virginia, where there are many other features, such as the sculpture of Carlsbad Cavern's mighty corridors and columns, and of a hundred lesser caves that honeycomb the limestone regions of the world challenge the artistry of the finest photographers.

Nature, with endless time at her disposal, has created pinnacles and minarets, waterfalls, arches, bridges, underground rivers, cascades and terraced balconies, delicate lace-like tracery and massive pillars—an infinite variety in a buried fairyland—that baffles verbal description but not the camera's lens which is nearly all-seeing.

The majesty of tremendous caverns is rivalled by the beauty of tiny, fantastic sculptures such as can be found in numberless small caves throughout the country. There are probably caves within a few hours' drive of your home.

PHOTOGRAPHING CAVE CREATURES

When you find your first bats, whether by the bushel or as a few solitary individuals, don't be alarmed. Most of the stories about bats are only superstitions. They never get into anyone's hair, and they have fewer lice than your neighbor's chickens or the robins that nest in the park. You'll find these little winged mammals to be the easiest of all cave animals to photograph

if you'll visit a bat cave between October and April when they hibernate, hanging head downward through the winter.

I've photographed as many as 15,000 bats at one time, a tremendous curtain of them in Marvel Cave, in the Ozark Mountains of Missouri. I put my camera on a tripod for that picture

because I found it hard to locate and keep my field in the darkness. In focusing on such a tapestry of bats, I slowly swing my flashlight's beam around the cluster to make sure that all of it is included in the view finder.

Cave creatures are small. Salamanders and crayfish range from three to seven inches in length, several species of bats measure only two inches from nose to toes as they hang asleep, while virtually every other cave inhabitant is still smaller, right down to blind beetles a quarter of an inch in length. To photograph these, special equipment will be needed, of course.



LONG-EARED BAT. This bat's ears measure 1-1 2 inches. It was held in the hand during exposure. DATA: Leica IIIa, Hektor 135mm lens, fast pan film, 1/4 second, f 11, copying attachment, one 250-watt projector
Photo, Charles E. Mohr



BLIND CRAYFISH. Colorless and sightless, this crayfish is common only to the Mammoth Cave region of Kentucky. DATA: Leica IIIa, Hektor 135mm lens, fast pan film, open flash, f 4.5, copying attachment, one No. 11 photoflash bulb
Photo, Charles E. Mohr

You'll find that salamanders are restless subjects, but that they are sluggish when compared with insects. Most attractive of cave insects is the sleek, beautifully-marked cave cricket whose antennae reach four times the creature's length. Usually they can be found near the cave entrance, along with mosquitoes. Both of these insects, as well as an attractive pink moth, leave the caves at intervals. The tiny blind beetle is one of the few permanent cave dwellers.

EQUIPMENT

A long focus lens such as the Leica 135mm lens is necessary for photographing the more active cave inhabitants, such as owls and cave rats. I found one owl perched on a ledge on the far side of a roaring, 10-foot-wide Indiana cave stream. I set up my camera and telephoto lens on a tripod, then set off the flashbulb low and to one side to silhouette the owl against strong shadows. The owl, rarely seen in caves, evidently was hunting bats. That owl was wary but cave rats, related to the western pack rats, have scurried unconcernedly about their nest while I shot pictures of them at a distance of only 6 feet.

In order to get large negative images of very small cave creatures, I use a sliding focusing copying device, known as the Fuldy attachment, on my Leica. On its groundglass, I focus and compose a picture of an individual bat or a cave salamander, and using a 135mm lens without extension tubes,

can work within 2 or 3 feet of the subject. Focusing is done very conveniently by turning the lens barrel.

A wide-angle lens, too, is ideal for cave photography, both for its great depth of field and for its wide field at close range. Cave quarters often are cramped and such a lens proves indispensable in getting pictures of cave formations.

Commercial caves are often difficult to photograph because wiring, light bulbs, and other unnatural "improvements" can not be eliminated from the picture. Lighting may be quite spotty from a photographic standpoint, but during a long exposure, light can be effectively "painted in" with a hand



PHOTOGRAPHING BLINDFISH. Underground motion pictures are practical only in electrically-lighted caves, as portable generators are too heavy and bulky, in general. But with four No. 2 photofloods, as shown, there is enough illumination to take Kodachrome movies at normal speeds, although half speed is used sometimes. The movie camera shown here is a Victor Madel 4 with an Eastman 2-1 2-inch f/2.7 lens, Dallmeyer f 2.9, and a 15mm wide-angle lens. Notice the sturdy tripod with tilting top, the head flashlight worn by the author. Photo taken at Mammoth Onyx Cave, Kentucky. DATA: Leica IIIa, Elmar 35mm lens, open flash, f 9, one No. 16A photoflash bulb
Photo, Charles E. Mohr

CAVE PHOTOGRAPHY

floodlight. While pictures of cave formations may produce artistic compositions, interest as well as scale is achieved when human figures are introduced.

Cave conditions are hard on cameras. The sticky clay is as annoying as the fine dust which sifts through all one's equipment. Dripping water and unexpected pools are further hazards. But with fore-



SCREECH OWL. Owls are apt to be found in almost any cave and are good subjects for cave photography. This open flash shot is a good one. DATA: Leica IIIa, Hektor lens, fast pan film, open flash, f 4.5, and Na. 16A photoflash bulb
Photo, Charles E. Mohr

thought and care no serious harm need come to your equipment. Cave floors are usually so far from flat that one eventually learns to tell at a glance whether or not it is possible to get a camera into position near enough to the animal to photograph it.

FLASH WORK

Open-flash technic works to perfection in the darkness of a cave. There are still men who use flash powder underground, but I prefer flashbulbs despite their greater bulk and higher cost. The tiny bulbs now available enable you to carry a large supply and yet crawl through extremely tight passages, and in the close quarters of a cave, the smokeless feature of flashbulbs is especially appreciated. Wide differences exist in the reflecting quality of cave walls. Those covered with flowstone or travertine, particularly when it is white or nearly so, are easily illuminated, but the water-worn, clay-covered walls of the great underground

canyons that characterize many Kentucky caverns, require a large battery of well placed giant flashbulbs. For such pictures, flash powder may be advantageous.

ANGLES

Sometimes a salamander is found on the floor of the cave, perhaps at the edge of a pool. I get down to its level by using a tiny metal tripod into which the legs can be set at four different angles. The widest spread puts the camera so low that my chin is on the floor when I focus. That is how I secured several of my best salamander pictures. The tiny tripod is essential, too, when the ceiling is very low. With a Leica and such a tripod, I've photographed a bat which hung on a cave ceiling that was only 15 inches above the floor.

Bats hanging at heights of from 3 to 7 feet above the cave floor, however, make the best subjects. The most effective close-ups can be made at the bat's level. This assures sharpness of detail of its feet clinging to the ceiling or wall, and of its ears below. Inci-



HIBERNATING PIGMY BAT. In many of the caves of this country bats will be found—sometimes in the thousands. When hibernating, hanging upside down from a cave ceiling, they are easy to photograph. This one was found in one of the tunnels of Pennsylvania's cross-country highway. DATA: Leica IIIa, Hektor 135mm lens, medium pan film, open flash, f 12.5, copying attachment, Na. 11 photoflash bulb
Photo, Charles E. Mohr

THE COMPLETE PHOTOGRAPHER

dentally, editors seem reluctant to publish a picture showing a bat hanging head downward, the only way, of course that bats ever hang.

You can give your pictures a dramatic touch by getting a worm's-eye view of the cave inhabitants. Make them different from the conventional bird's-eye views which have long illustrated scientific literature. You can get down to the level of a salamander, for example, in several ways. If the slippery amphibian is crawling along some ledge, it is easy to photograph it from the same level or even from slightly below.

SPECIAL PROBLEMS

Very often the salamander will "freeze" briefly. Then while a companion holds a flashlight beam on the creature, focusing can be done in a few seconds, lens stopped down, camera slid into place, and flash set off, all before the amphibian has been disturbed. With a shot "in the bag" you can

afford to experiment with lighting effects, directing the beam from various angles until you find the best position for illumination. When a salamander decides to leave, however, photography is over, for once disturbed it is not likely to settle down again. I've followed them with my camera for half an hour without getting a picture. That's why it's rarely possible to pick up a salamander and place it where you want it. It won't stay there.

In Mammoth Onyx Cave, Kentucky, I discovered a salamander guarding her eggs in a tiny crevice 10 feet above the base of a fluted column. The find was scientifically important because the eggs of this salamander had never before been seen. Standing on a stalagmite 6 feet away, I could look directly into the crevice, but the floor fell away in front of me. By building stone piers and using a tall wooden tripod, I raised the camera to the level of the nest. The crevice was scarcely $1\frac{1}{2}$ inches wide;



SALAMANDER. Solomanders ore moist-skinned omphibions which die if exposed to heat or dryness. Rarely da they remoin matianless in bright light for more thon o few seconds—which makes the photagropher's job difficult. This excellent phatagraph was made possible by quick focusing and striking spatlighting. DATA: Leico Illo, Hektor 135mm lens, fost pan film, 1 2 second, f 11.5, capying attachment, 100-watt projectar
Photo, Charles E. Mohr

CAVE PHOTOGRAPHY



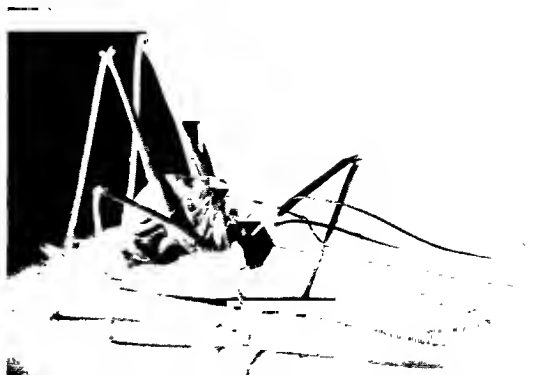
SALAMANDER GUARDING EGGS. Since this is one of the few pictures of a salamander with her eggs, the photograph has great scientific value. Found at Mommath Cove in Kentucky, this salamander had retreated to a deep crevice—almost hidden from the photographer's lens. The taking of this unusual cave shot is described in the text. DATA: Leica IIIa, Hektor 135mm lens, fast pan film, 1 second, f 12.5, 30mm extension tube, copying attachment, and 100-watt projector

Photo, Charles E. Mohr

the camera almost blocked the opening. Illumination was a problem. Fortunately, this was a commercially developed, electrically lighted cave and I had with me a 100-watt miniature projector. Using it as a spotlight, I probed into the crevice with its beam and so secured some interesting record shots, even though I couldn't get the whole field sharply in focus.

Five years ago, I turned a spotlight on a dead, posed cave cricket with pleasing results. The picture was effective, I thought, but not quite true to life, so I tried shooting live ones. Invariably they hopped away.

At last, in a commercial cave, I constructed a box of lantern slide glasses, bound it together with transparent scotch tape, and set it down over a cricket. Then leisurely I set up my camera. Experimenting with my projector-spotlight, I discovered that when the beam came from directly overhead the glass walls of the enclosure were invisible. Eventually the bewildered insect paused in its exploration. I switched on the light, held it a few inches above the cricket, and made it half a dozen exposures at from $\frac{1}{4}$ to 1



POSED CAVE CRICKET. This specimen was found, dead, in a cave and photographed while mounted on a strip of adhesive tape. While this gives a good idea of the cricket's structure, the photograph is not satisfactory. The antennae, for instance, are drooping and unnatural. Compare this shot with the accompanying one of a live cricket. DATA: Leica IIIa, Hektor 135mm lens, fast pan film, 10 seconds, f 18, copying attachment, and spotlight
Photo, Charles E. Mohr



LIVE CAVE CRICKET. This cricket, with his long antennae extended, was photographed in its cave—momentarily placed under a homemade glass "cage." The cricket is an extremely restless creature and is best photographed in this manner. Attempts to photograph a dead cricket (see accompanying photograph) are not satisfactory. DATA: Leica IIIa, Hektor 135mm lens, fast pan film, $\frac{1}{2}$ second, f 11, copying attachment, one 100-watt projector
Photo, Charles E. Mohr

THE COMPLETE PHOTOGRAPHER

second, at apertures from f/6.3 to f/11. Then the cricket was on the move again, but I had secured a unique picture.

FILM AND DEVELOPMENT

Either a fine grain or a moderately fast film is suitable for most cave photography. I prefer the latter, having used DuPont Superior Panchromatic and Agfa Superpan Supreme almost exclusively. Development has usually been in Champlin No. 15.

When exceptionally large caverns are being photographed, particularly those without travertine-covered walls, the fastest film available should be used. In addition, it may be wise to hypersensitize the film.

COLOR WORK

Cave creatures are colorful. There are yellow, orange, and red salamanders. Others are black with silver spots. They make wonderful subjects for color photography. Bats too, show considerable variety of color—ranging from yellowish and reddish to chocolate brown. Most beautiful of all cave creatures are the creamy white, blind crayfish that live in certain caves in Missouri, Indiana, Kentucky, Tennessee, and Florida.

On some trips, I've carried two cameras, each with a copying attachment so I could use them interchangeably. A strip of red scotch tape across the top identified the color camera. Whenever a photograph was made in black and white that was needed also in color, the first camera was slipped out of the copying attachment, and the second camera was slipped into place. The lens, of course, remained in focus for the second picture; only the aperture was changed, from f/12.5 to f/9 for color. A strip of scotch tape on the focusing ring aided in locating these two apertures.

The reflector was held at a uniform distance, about 4 feet, for all pictures, and the flashbulb of lowest intensity was used. Working at closer range or using more powerful bulbs makes a considerably smaller lens stop possible.

Kodachrome A is best adapted for cave photography, either with flashbulbs or with mazda or photoflood illumination (possible in electrically lighted caves). Where a color picture will show the entrance to a

cave, however, ordinary Kodachrome must be used to secure normal coloration of the sunlit portions of the scene, while the dark portions are illuminated with a blue or daylight flashbulb. Very beautiful effects can be secured by this method. As in other types of cave pictures, persons in the scene add greatly to the interest and to the depth of color photographs.

MARKETS FOR CAVE PICTURES

Cave exploration and photography was a popular form of recreation in Europe before the war and half a dozen journals devoted to cave animals or cave exploration were published. The scientific study of caves is known as speleology and the first American group of speleologists, organized in Washington, D. C. in 1939, has recently expanded to form the National Speleological Society. One of the objectives of this society is to explore, map, and photograph all known caves.

Owners of caves usually are in the market for pictures of their caves. Since the average quality of such publicity pictures has been low, enterprising photographers should find this a rich field.

With the increasing use of natural history pictures in newspapers, in science magazines such as *Natural History*, *Frontiers*, and *Nature Magazine*, and in more general magazines as well, good photographs of cave animals and of cave scenes should have a ready sale. Likewise such pictures may appeal to the judges of photographic salons, particularly to salons of natural history photography such as are held by The Academy of Natural Sciences of Philadelphia, by the Buffalo Museum of Science, by The New England Museum of Natural History, and by *Scientific American*.

Whether your objective be the production of prints for photographic salons, for publication or sale, or simply to form a pictorial record of your subterranean adventures, your camera will be an indispensable part of your caving equipment as it has been of mine. The photography will make your caving much more interesting. And surely, if you are scientifically inclined, a photographic record of your trips and observations will not only help you, but other scientists as well.

CAVERN PHOTOGRAPHY

CAVERN PHOTOGRAPHY

Ray Scott

Former Official Photographer, Mammoth Cave

The author of this article photographs caverns and their formations as a business and knows all the problems of an underground photographer. Lighting and angle of view are of major importance and we are told how to light stalactites, frozen rivers, and other formations, what equipment to use, how to achieve good composition. Color work is also covered.

All photographs taken by Ray Scott at Mammoth Cave

See Also Cave Photography

ALTHOUGH cave photography has its limitations professionally, many amateurs pursue this fascinating field with enthusiasm.

Probably the most widely known of all the caves throughout the country is Mammoth Cave in the Kentucky Cave Region. This immense cavern has nearly 200 miles of chartered routes—covering underground rivers and lakes, yawning pits and massive domes, imposing arched corridors, winding channels, brilliantly colored cave onyx in stalactites, stalagmites and flowstone, and clusters of gypsum that adorn the cavern walls like snowy icicles.

As publicity photographer at Mammoth Cave during the past three years, I have met with and solved many difficult photographic problems. I have explored with adventure-some guides in new discoveries of Mammoth Cave, being the first to photograph many features that were declared by scientists to be the most amazing of any known cave formations. Since these new beauties are not yet open to the public, I shall explain some of the problems encountered in photographing such well known features as Echo River, Frozen Niagara, Star Chamber, Martha Washington's Statue, and Violet City. Each of these features presents an individual problem, but before going into a detailed description of the process involved, I shall touch briefly on such fundamentals as angle of camera, composition, lighting, balance, and models, all of which are as

important in cave photography as in any other photographic field.

CAMERA ANGLE AND LIGHTING

The camera angle is of primary importance. In order to place the proper emphasis on the features being photographed, much care must be exercised to show the point of attraction from the most effective angle.

Composition is rather complicated in cave photography. In some parts of the cave there are no electric lights; therefore, focusing and composing must be accomplished by the aid of a gasoline lantern. In the electrically lighted portions of Mammoth Cave, this procedure is less difficult.

Lighting is the most difficult operation in making a cave photograph. In this gigantic studio, all lights must be placed for the most effective results, keeping in mind the purpose that the finished print is to serve. To achieve this, it is necessary to experiment with lights (lanterns or photofloods) before making the exposure. Clever manipulation of lights and shadows can do much in placing the proper emphasis on a particular



PURGATORY SLOUGH. This huge tunnel was cut by an underground river—ages ago. The light at the far end of the cavern was set off by an assistant. DATA: 10 seconds, f 22, one magnesium flare, one powder flash

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HELECTITE. Taken with synchroflash equipment, this photograph shows one of the rarest of cave formations. DATA: fast pan film, 1/100 second, f/32, one press flashbulb

point of interest. Thus the resulting picture is well balanced and appealing to the observer.

In my experience with lighting equipment, I have found that photoflash bulbs are best for illumination. However, in some instances I have used photofloods and magnesium flares.

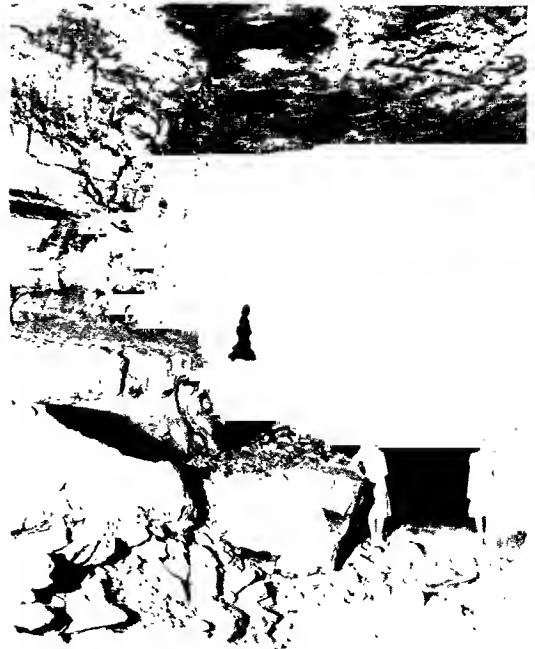
The selection and placing of models plays an important part in each picture. Since the most of my pictures are used for publicity purposes, the features and formations must appeal to the traveling public. One of the best ways to accomplish this is to include two or three people in each scene, thereby appealing to human interest, the primary psychological factor of all picture appeal. The models should always be placed to conform with the balance and composition of the picture, and at the same time serve as a scale—especially important in cave photography.

EQUIPMENT

The photographic equipment for my cavern work consists of a 4 x 5 Speed Graphic with a 6-inch Schneider Xenar f/4.5 lens, a

supplementary 5 $\frac{1}{4}$ -inch Skopar f/4.5 lens and 3 $\frac{1}{2}$ -inch Schneider Angulon f/6.8 wide-angle lens. These supplementary wide-angle lenses are necessary for photographing large formations in narrow passages. A Mendelsohn Model C DeLuxe Speed Gun with extension cords and reflectors is used in various places where a tripod is inconvenient; and is also used when photographing such cave animal life as the eyeless fish, and bats. Other equipment consists of a Leica G, with 50 mm Summar f/2 lens, supplementary 35mm Elmar f/3.5 lens for wide-angle work, and 135mm Hektor f/4.5 telephoto lens. This camera is used mostly for Kodachrome, when natural color slides are used both for publicity purposes and as slides for projection in lectures.

For the Speed Graphic, I prefer the fast panchromatic films, since the super speed is essential for good exposures with photoflash and photoflood lights. This film speed also makes it possible to stop to smaller openings, thereby giving a greater sharpness of detail and the added depth of field that is necessary in this type of photography.



MARTHA WASHINGTON'S STATUE. This is not on actual rock formation, but on illusion created by light. Such phenomena are hard to photograph. Notice how the figures improve the picture and give it scale. This photo is discussed in the text. DATA: 10 seconds, f/11, two press flashbulbs

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ECHO RIVER. This photograph, discussed at length in the text, gives an excellent impression of the low-ceilinged, still, eerie underground river. DATA: open flash, f 11, one gasoline lantern, two flashbulbs

I find the small press flashbulbs very good for general use, as their small size and light intensity make them very desirable when carrying a large supply for a day's work in the cave. When more than one bulb is required, two or more may be fired from different locations to obtain the desired effect. Sometimes I find it more convenient to use the larger bulbs, where an unusual amount of concentrated light is needed.

I use a heavy steel tripod with tilt top and pan head. However, any substantial tripod is adequate for cave photography. A canvas or leather zipper bag makes an ideal carrying case for reflectors, flashbulbs, extension cords, and all types of equipment.

TECHNIC FOR ILLUSTRATIONS

The following detailed description explains some of the complications of cave photography and the methods by which the accompanying illustrations were obtained.

Martha Washington's Statue. This life-like statue of Martha Washington is an illusion created by light shining on the cave walls, the outlines being made by a sharp turn of the cave channel. The distance from the camera to the reflection was about 250 feet, so the camera was focused on infinity for the first exposure, which was 20 seconds at f 8 with camera firmly on tripod. The light was a bengal flare that is used by the guides when showing this feature. The slide was placed back in the film holder and removed from the camera. With the aid of a gasoline lantern, I refocused on the two girls who are shown in the picture. The cut-sheet film that had been exposed on the "Statue Illusion" was then replaced, and an openflash exposure was made at f 11, with two press flashbulbs, placed about 10 feet to the left of the camera.

Echo River This underground river, the most famous of all cavern streams, is of un-

known length and with an average depth of 30 feet—one of the principal attractions of Mammoth Cave. A silhouette was decided upon here, to enhance the mystery of the cavernous stream. Focus was achieved with the aid of a gasoline lantern in the boat, which was about 50 feet from the camera. Two of the boys in the boat assisted with flash reflectors; the one at the right end of the boat, directed his reflector, which was loaded with a large flashbulb, up the river for additional light. The other boy at the

bottom of the bowl. Top lighting was decided upon to prevent glare and to provide the best angle of illumination. To achieve this, as well as to stop probable motion, synchroflash was used, with an assistant holding the reflector, on extension, about 2 feet above the bowl.

The camera was placed on a tripod and, with the aid of a gasoline lantern, I focused on one of the fish which happened to be near the edge of the bowl, carefully gauging his exact distance from the glass, which was to

be my plane of exact focus.

By this arrangement the subject would be approximately 3 feet from the lens, which was stopped to $f/32$.

Having made these preparations, I set the shutter to 1/50 second, cocked it, drew the film slide, placed a press flashbulb in the reflector and waited. Since there was no lure visible to this eyeless native of the underworld, it was necessary to await his approach. These fish are naturally sluggish, due to the cool cave temperature which rarely varies from 54° F., and so the waiting of minute after minute became monotonous. Eventually,

after I had become thoroughly discouraged, he glided into position and was captured with the blinding flash.

The Cave Management announced that, to their knowledge, this is the first time in the history of the cave that the Eyeless Fish have been successfully photographed.

Frozen Niagara. This magnificent and impressive formation of cave onyx, a miniature replica of the icy falls, is one of the most beautiful and outstanding features of Mammoth Cave. This is the largest formation in the entire cave, being 40 feet in width and 75 feet in height. It is so situated that it is necessary to photograph from one particular angle for the best results. Since this point is only 20 feet from the formation, a wide-angle lens is required in order to include all or most of the view.



EYELESS FISH. Patience and planning were required to photograph this strange cave fish. The procedure is explained by the author in the text.
DATA: 1/50 second, $f/32$, one press flashbulb

left end of the boat, flashed a press flashbulb, which he held behind his back, toward the opposite bank to produce the light for the silhouette. The two reflectors were synchronized with a connecting cord in order to prevent a blurred image, which might have resulted from the drifting boat. Exposure was open-flash at $f/11$.

Eyeless Fish. These eyeless and almost colorless aquatic creatures are found in Echo River and small streams in Mammoth Cave. Because they are quite elusive, a few specimens are maintained in a glass bowl near the Cave entrance for the convenience of the cave visitors. It was these particular ones that provided one of the most interesting problems of all encountered.

In order to provide a naturalistic setting, a small amount of gravel was dropped into the

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Here, again, side- and backlighting proved to be desirable, because the lower part of the "Falls" consists of fluted columns in mass of stone from which this type of lighting creates a definite form from light and shade graduations. For models, a girl and one of the guides were selected to stand on the steps which lead to the "Foot of the Falls." The Guide also acted as my assistant in the operation of the flash equipment.

For the main light source, a large No. 3 flashbulb, in reflector, was placed on a rock at the foot of the steps, shielded from the lens by a protruding boulder. An extension to this reflector led from a three-way flash unit which was held by the guide. This unit, which was loaded with a press flashbulb, and directed toward the far wall, was shielded by the body of the guide. The No. 3 bulb was directed toward the main body of the formation, thereby making a silhouette of the models. A No. 2 photoflood, which completed the lighting units, illuminated the top of the formation. A wide-angle lens was used here, stopped to *f* 18, with an open flash exposure.

GENERAL HINTS

The photographer cannot be too careful in checking on technical details, while making exposures inside the cave. He must be very careful to have sharpness over the entire field of view, by using a small stop opening, if necessary. Reflections from light formations in some places, will lessen the amount of illumination needed, whereas, with dark walls or formations, more light must be used for the same amount of space involved. It is also necessary to double check on focus, diaphragm stop, and position of lights before making

the exposure, since all preparations are carried out in semi-darkness.

In addition to the photographic possibilities in Mammoth Cave, enumerated in the foregoing paragraphs, an unlimited number of features offer subject matter for natural color photography though technic here must be very careful.

The onyx and gypsum formations are richly colored in the various shades of red, yellow, orange, sienna, brown, and even varying to blues and purple. The emerald green waters of Crystal Lake and the multi-colored flowstone adorning the walls is a scene of enchanting beauty, which can easily be recorded on natural color film. Other pictorial features include the Golden Fleece, The Drapery Room, Onyx Chamber, The



FROZEN NIAGARA. This huge formation of cave onyx is about 40 feet wide and 75 feet high. A wide-angle lens was used to get in as much of the frozen cascade as possible. Other details of the photographing procedure are given in the text. DATA: wide-angle lens, open flash, *f* 18, two flashbulbs and one photoflood



CRYSTAL LAKE. This shows interesting use of the high angle in cave photography. Such shots must be carefully planned and posed, as the so-called "candid" are virtually impossible due to uncertain lighting conditions. This was taken with flash lighting coming from one source—directly below the camera. Notice the transparency of the "cystal" water

Marble Temple, and Frozen Niagara, all of which have innumerable color possibilities.

When making Kodachrome exposures, both with 35mm and 4 x 5 film, I have found that photofloods are best for lighting. By the proper lighting arrangement and by giving short time exposures, excellent results have been obtained. An average exposure with two No. 2 photofloods, placed 10 feet from the subject, is from 5 to 10 seconds at f 11, when using 35mm Kodachrome film. This exposure must be doubled for Kodachrome cut-sheet film. The exposure will also vary according to the color of the formations. The best results from natural color cave photography will be obtained by flat lighting.

I have given in this outline the fundamentals of cave photography. The procedure followed in photographing Mammoth Cave may be applied in photographing the features of any cave. The photographer who wants to try new adventures with the lens will find that worthwhile and interesting experiences await him underground.

CENTIGRADE SCALE. The Centigrade system is one of three used to measure temperature. The others are the Réaumur and the Fahrenheit. In the Centigrade scale the freezing point of water is at 0° and the boiling point at 100°. Réaumur uses 0° for the freezing and 80° for the boiling points of water, while Fahrenheit is based on the temperature of equal parts of ice and salt. The freezing point of water, in Fahrenheit, is 32° and 212° is the boiling point.

The Centigrade scale is universally used, especially in scientific work, although Fahrenheit is the familiar scale used in our everyday outdoor thermometers. The Réaumur is slowly becoming less and less used.

To convert Réaumur to Centigrade, multiply by 5 and divide by 4.

To convert Fahrenheit to Centigrade, subtract 32, multiply by 5, and divide by 9.

CERAMIC PHOTOGRAPHY. It is possible, actually, to place a photographic image onto almost any base—whether silk, wood, leather, glass, or paper. One interesting variation to the photographic process is ceramic photography, the vitrification of an image on porcelain. While amateurs are not usually equipped with the glazing apparatus, they can prepare the material and send it to a local pottery furnace.

According to Wall and Jordan in *Photographic Facts and Formulas*, one way to transfer the image to porcelain is with the carbon process. In this, the porcelain or other material is merely the final support for the transferred image. It is coated with a chrome gelatin as follows:

Soft gelatin... 450 grains 60 grams
Water..... 14 oz. 875 cc
Soak gelatin for 30 minutes, dissolve in water, boil, and add:

Chrome alum. 10 grains 1.25 grams
Water.... 2 oz. 125 cc

The carbon image is prepared and merely transferred to the porcelain and fixed in the usual way (see *Carbon Process*).

The image may also be laid onto the porcelain base by the collotype process (see *Collotype Process*). After a special enamel covering, the porcelain is fired in the usual way.

CHARACTER STUDIES

CHANGING BAG. When the photographer has no darkroom or other light-tight room available, a changing bag will come in handy for the loading of film into cameras or into developing tanks.

There are a variety of changing bags on the market—some which are merely pieces of black cloth with armholes and others which are elaborate affairs made up of a light-tight box fitted with long elastic-ended armholes. The main purpose is to let the photographer slip both arms into a small dark area, through sleeves with rubber or elastic bands around them to keep out the light. With this procedure cut-sheet film or bulk roll film can be loaded into holders, jammed cameras can be fixed, or daylight loading developing tanks can be filled.

The bag must have some opening in the working area—a zipper top for the loose bag and a hinged cover for the box type—through which the tanks, film, scissors, and other working materials can be passed. This must be absolutely closed before work proceeds, of course. Particularly handy for the traveling photographer, it can be used in the field as a light-proof and dust-free “dark-room.” The bag should not be bulky. And scrupulous care must be taken not to damage the bag in any way, as repaired bags are never absolutely reliable.

CHARACTER STUDIES

Bernard Hoffman

Staff Photographer, Life Magazine

In today's picture magazine the public sees excellent photography—not the least of which is a new kind of character study. Mr. Hoffman has a simple formula for taking informal portraits of people, from the great to the unknown. We are told of lighting arrangements and how to distract the subject by one of the photographers who has helped to give a new meaning to the words “character study.”

All Photographs by Bernard Hoffman.

See Also Flash and Synchroflash Photography, Portrait Photography

IN THE photographic salons of the pictorialist there are many prints entitled “Character Study” which are nothing more than an average American businessman all made up with false whiskers, a bandanna, and a knife between his teeth—supposed to be a “desperado” or something. That is not

my idea of a character study, because there are plenty of real characters walking the streets or sitting in your own home who would make excellent studies without benefit of costumes, make-up, or even dramatic lighting and texture screens.

Especially with the growth of photographic journalism and the interest of that journalism in people—real people as themselves—a different type of character study is being shown to the public. The picture magazines are most particularly the ones which use this kind of character study. The photographer has invaded the homes, offices, and churches of these “characters” and has made natural setting, natural clothing, as important as natural expression and action.

DIRECTING THE SITTER

Few people can be natural in front of the camera. Sitting for a portrait is to the average person like sitting alone in an empty room while fully aware that a hidden observer is watching every move. It's an uncomfortable feeling. The biggest job that the photographer has is to dispell that feeling. Exposure, lighting, and the other me-



“TAKE MY PICTURE.” The photographer says of this picture, “Returning from American Legion Convention, walked into lobby of my office building late at night. The scrub woman spied the camera, shouted, ‘Take my picture.’ I took this flash shot—nearly scaring the woman to death.” DATA: Ikaflex, fast pan film, 1/250 second, f/11, single flash
Photo, Bernard Hoffman



SWIMMING COACH. A clever character study is this portrait of the Chicago Water Ballet's swimming coach. Framed by some of his swimmers, smoking his cigar, and smiling at someone out of the camera's range—he makes a perfect pose. A good shot—helped by a sense of humor. DATA: Ikofolex camera, fast pan film, 1/250 second, f/11, 2 flashbulbs
Photo, Bernard Hoffman from Life

chanies involved are of comparatively little importance; at least they can be taken for granted.

So the photographer must first of all be a director. A good character study is usually a result of good direction on the part of the photographer. This is true of all types of character studies whether they are of individuals, groups, towns, cities, or animals. In the case of animals, and some individuals, good direction usually has to be replaced by sheer patience.

Individuals are the most difficult subjects, for they must remain individuals. They cannot blend into a background or become a part of anything. They are the center of attraction, they know it, don't know what to do about it, and consequently are under tension. How to dispell this tension is a matter entirely up to the photographer. Some subjects can be humored out of it, others talked out of it. Most subjects will

forget about their unfamiliar predicament if properly distracted.

How to distract a subject calls for some knowledge of human nature on the part of the photographer. When I was just beginning my photographic career I had the good fortune to be accepted as assistant to a grand person and swell photographer, Alfredo Valente. It was from him that I received an invaluable lesson in character study technique. We were in Hollywood at the time. I was doing my best to insure Mr. Valente's success by setting his lens at the recognized stops and handing him the proper plate holders on demand. One day we were asked to make a portrait of the highest mogul in the picture company for which we were working, the president himself. We received a full day's notice accom-

panied by some minor fanfare on the part of numerous secretaries and assistants, whose only job for the day seemed to be to remind us that we were to take a picture of The President Himself on the morrow.

Strangely enough, the sun still came up at 5 A.M. next day, and that evening The President Himself arrived. He was no actor. In back of his desk he was a great man, but in front of the camera he was a complete nonentity. He was terribly self conscious. One of his first actions was to have a life-sized two-section folding mirror placed next to the camera so that he could see what he looked like every time he turned to the lens. He would take no orders. It was gruesome. It wasn't a sitting at all. It was a battle of nerves. The subject just sat there and dared Alfredo to make a good character study. It was as tense a situation as I've ever seen.

Then a strange thing happened. Mr. Valente walked to the rear of the studio, sud-

CHARACTER STUDIES

denly turned around, and started running like greased lightning for his subject, flailing his arms about and making strange noises all the while. When he drew within a foot of his subject he skidded to a stop, shouted "BOO!" into the face of the bewildered man, grabbed the camera bulb, and got the first of a series of fine photographs. The ice was broken. The nervous tension disappeared. The subject laughed. At that point even the mirror was removed.



WILLIAM ALLEN WHITE. An animated photograph of the great newspaperman, this study shows White to be a genial man. **DATA:** Korona View 5 x 7, Tessar lens, fast pan film, open flash, $f/64$, 3 flashes

Photo, Bernard Hoffman from Life

In this particular case this rather drastic method was effective. In another case it might have proved a complete failure. It might easily happen that the photographer would rush up, shout "Boo!", and have the subject drop dead of heart failure. Or still worse, depending on the way you look at it, it might get the photographer a good, swift punch on the nose for his trouble. Good direction, therefore, should be coupled with some understanding of human nature.

THE DISTRACTION TECHNIC

I am not a particularly good director. Although I do have my own opinions, I am still



HOLLYWOOD CHARACTER STUDY. This portrays Thomas Mitchell as the "bosun" in *The Long Voyage Home*. Hollywood publicity stills are often excellent character studies

Photo, Ned Scott



OLD COUPLE. A far cry from the "family album" kind of portrait is this one—a true character study of two people. Notice how the background helps to establish character. **DATA:** Korona View 5 x 7, Tessar lens, fast pan film, open flash, $f/45$, 3 photo-flashes

Photo, Bernard Hoffman from Life



APPLE PEELER. This study is of a real character—and it was not caught by a pictorialist, but by one of the Farm Security Administration's documentary photographers. Such photographs speak a wealth of words—and make costumes, make-up, and settings seem extremely unnecessary
F.S.A. photo, Arthur Rothstein

too susceptible to the suggestions of others. But I know where my weakness lies and I've developed a system to cover this fault. When I take photographs I use another variation of the distraction technic. I talk to myself. I've always talked to myself more or less, while at work, and in my picture taking I do this with a purpose. The subject soon becomes interested in my mumbling and forgets about him or herself.

While moving around getting my equipment in order I will occasionally stop close to my subject and mumble something that I figure will arouse an interest, like: "This morning I got up and looked at my watch."

or "Why don't you shoot your husband. I'll divorce my wife and we can go to a movie together." My remarks are never addressed to the subject, and as soon as they are spoken I quickly move on and leave my subject to figure it all out. So far I've always found my subjects to be pretty pliable after a few minutes of this treatment.

I don't know why the technic works but it does. Maybe I look the part and it would not work with another photographer. Possibly the old story about gifted people being slightly cracked, or cracked people having something on the ball that we normal people do not have, has something to do with it. I

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lay no claim to being either gifted or cracked. I'm just another man who loves his work. If my subject should ask what I'm talking about I merely apologize and explain that I always talk to myself while at work.

LIGHTS

I try to get my pictures as sharp as is possible. For illumination I prefer the use of flashbulbs. On most pictures I use the open and shut technic. This assures me of the most



CARL SANDBURG. This is a well-known study of a well-known poet and historian. With this, a certain amount of posing was done, especially with the hand and cigar. But still it is Carl Sandburg—as he is.

DATA: Korona View 5 x 7, Tessar lens, fast pan film, open flash, f/45, 3 flashbulbs

Photo, Bernard Hoffman from Life

usually closer than my basic lights and is naturally stronger. My basic lighting can be varied with surprising accuracy.

GENERAL TECHNIC

Expression, and a good reporting job is always my paramount objective. A good picture, I believe, must reflect some variation of my subject's personality. I do not believe in designing steam bath effects for my subjects to dreamily peer through, nor can I see any reason for substituting a mechanical screen effect for natural texture. I have no desire to create a mood around my subject after the picture is taken. My interest is in capturing the actual mood. This I try to do as simply as possible.

I do not feel that I can honestly improve on a good first impression. Therefore I spend a lot of time in taking my pictures, and a minimum of time in fussing around in the darkroom. My darkroom technic is a normal processing job. All

negatives are developed in Eastman's DK20. This formula gives me very satisfactory results with all my negative sizes, from 35mm to 3½ by 4½ inches. Prints are developed in Eastman's D72. I dodge and crop as the occasion calls for. Most of my cropping takes place at the enlarger where I usually make my final composition.

In conclusion, I would like to say that the only way to get a good character study is to press the button at the right moment. If you know a good picture when you see one, you'll know when the right moment arrives. A photographer must also bring with him the right point of view. You can't take a character study of a group, or town, or person without first knowing something about the



CHARACTER STUDY OF A GROUP. This "Dog House" in New Orleans provides an amazing group study. Notice the people—some bared, some interested, some embarrassed. Notice, too, the cop playing blockjack with customers in the background. A picture like this is one step away from the "moss character study," as individuals are important here. DATA: Ikoflex comero, fast pon film, 1/250 second, f/6.3, single

Photo, Bernard Hoffman from Life

powerful light source available, the smallest aperture for maximum depth and clarity, and an exposure so fast that the subject is not required to hold a pose. My lights are arranged so that I always have an even basic light source which gives all-over illumination regardless of my subject's movements. However, I try to avoid flat lighting by placing a pick-up light high and in back of the subject. My basic light is usually made up of one or two lights in front and to the sides.

Illumination is controlled by the use of bulbs and reflectors of a single type. Since all units will produce the same amount of light I can easily judge my lighting arrangements beforehand. My pick-up light is us-

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group, the town, or the person—without knowing whether they demand a straight treatment or something a bit dramatic.

But every photographer must work out his own way of bringing about a right moment. That takes quite a lot of practice—



INDIANA SENATOR. A straightforward, unadulterated close-up, this shows Ray Willis of Indiana. This kind of portrait has been used a great deal in such magazines as *Life* and while some may not like seeing every wrinkle, every hair and pore, for others it is these very details which transform the portrait into a true character study. DATA: Linhof 3¼ x 4¼, Tessar lens, fast pan film, open flash, 1/45, 2 flashes

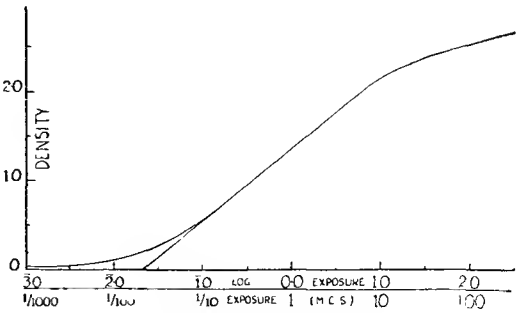
Photo, Bernard Hoffman from Life

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practice with your equipment and practice with handling people. But if you catch the right moment, you have a character study worth looking at.

CHARACTERISTIC CURVE. The characteristic curve is the graphic expression of an emulsion's density-exposure relationship. Sometimes called the sensitometric or D-log-E curve, it was developed as a result of the work of Hurter and Driffield in the field of sensitometry and so is often called, also, the H & D curve.

In order to calculate the curve, the film or paper emulsion is given regulation stepped exposures which are calculated with strict accuracy—and then developed in a standard formula according to uniform development methods. The densities, measured by a



Characteristic Curve

densitometer, are represented in the height of the curve and the logarithm of the exposures are on the base. The result is a curve (of varying shapes according to the emulsion) having a "foot" or base, a middle straight-line portion, and a "shoulder" or



CHARACTER STUDY OF A TOWN. This is Franklin, Indiana—a typical American town on any Saturday night. It shows that people in a mass make an interesting group character study and that all "characters" are not individuals. Each person, in this, has been subdued as an individual and we concentrate only on the general attitude of gaiety and weariness, of hurry and waiting. DATA Linhof 3 1/4 x 4 1/4, Schneider Angulon lens, fast pan film, open flash, f/11, 3 No. 3 superflash bulbs
Photo, Bernard Hoffman from Life

CHEMICALS USED IN PHOTOGRAPHY

sloping off portion at the top. The straight-line portion is the area of correct exposure, where each increase in exposure causes a similar increase in density; the foot represents the area of underexposure; the shoulder is the area of overexposure.

Characteristic curves are used in determining the latitude and the contrast of emulsions. From these curves, gamma (or development factor) can also be calculated. (See also articles on *Bromide Papers*, *Developers*, *Gamma*, *Hurter and Driffield*.)

CHEMICAL FOCUS. When white light strikes a simple positive lens, the different colors come to a focus at different points. This is what is called chromatic aberration—where the red rays are bent less and have a longer focus and the violet rays are bent more and focus nearer to the lens. Every lens, in other words, has a different focal length for each color of the spectrum. The optical focus of a lens is the point at which the yellow-green rays form a sharp image, the point at which the rays from a theoretical single point light source would cross behind the lens. The *chemical focus* is the point at which the extreme violet rays form a sharp image. Most lenses are achromatic and corrected for this. With certain uncorrected lenses, the box camera lenses for instance, the presence of chemical focus is apt to cause a blurred image outline. The blurring caused by chemical focus may also occur with enlarger lenses.

To correct non-corrected lenses for chemical focus, reduce the distance between the lens and the negative by about 1/40 of the focal length for normal scenes, with more reduction for close-up work (*Photographic Facts and Formulas*, Wall). On some box cameras, it was the custom to move the film plane slightly to take care of this chemical focus. (See also *Lenses and Their Characteristics*.)

CHEMICAL FOG. Apart from the fog caused on negatives and prints by halation, light leaks, and overexposure, there is chemical fog. Fog is, according to Wall in his *Dictionary*, “a deposit of silver not forming part of the true image.” Chemical fog occurs as a result of the following:

Overdevelopment or forcing of an underexposed negative.

Developer which is too strong, without sufficient dilution.

Impurities in the chemicals of the developer, especially metallic foreign matter and hypo.

Too much alkali and too little restrainer in the developer.

Excess of sulfide.

Developer used at too high a temperature.

As in all “cures,” prevention is best and clean working utensils and careful technic will cure most chemical fog. However, the use of a reducer might help. And, in the case of the sulfide chemical fog, lead acetate may be used to restore the developer. (See also article on *Fog*.)

CHEMICALS USED IN PHOTOGRAPHY

Glenn E. Matthews

Technical Editor, Kodak Research Laboratories

In simplified form, this is a glossary of chemicals most frequently used by the photographer and in photographic materials. Mr. Matthews has, on purpose, omitted such technical aspects of the subject as the chemical formulas for each item and has, instead, told the importance of each chemical in a simple and understandable way.*

See Also *Chemistry of Photography* by Glenn E. Matthews, *Dictionary of Photographic Terms*

Acetone—In developers as an accelerator (reacts with sulfite to produce alkali); in film cements.

Acid, Acetic—Rinse bath between development and fixation of papers; in acid hardening and fixing baths; in film cement for motion picture film.

Acid, Boric—In certain types of developers containing borax; in fixing baths to decrease the sludging tendency and maintain hardening properties.

Acid, Hydrochloric—In toning baths and in the chromium intensifier; as a cleaning agent for trays.

Acid, Nitric—To dissolve silver in the formation of silver nitrate; in photomechanical processes for etching.

* Several of the chemicals in this list are corrosive and poisonous. Information on the physiological action of photographic chemicals may be found in the article on *Solutions, How To Mix Them*.

- Acid, Oxalic*—In ferrous oxalate developer; as a preservative of pyrogallol solutions; in mordanting and toning formulas.
- Acid, Pyrogallol*—Incorrect name for *Pyrogallol*, which see.
- Acid, Sulfuric*—In chrome alum fixing baths; in bleach baths, photographic reducer solutions, and in tray cleaners.
- Alcohol, Methyl (Methanol)*—For preparation of concentrated developer solutions; in film cement; as a cleaner for prints and negatives.
- Alum, Potassium Chrome*—As a hardening rinse bath for films and plates; in the preparation of emulsions; in acid hardening fixing baths.
- Alum, Ferric (Iron)*—In toning baths and in photographic reducer solutions.
- Alum, Potassium*—As a hardening agent in acid hardening fixing baths; in hypo-alum toning baths.
- Amidol*—See *Diaminophenol Hydrochloride*.
- Ammonium Bichromate*—As a sensitizer in photomechanical processes and in special printing, such as bromoil and gum bichromate methods.
- Ammonium Chloride*—In rapid fixing baths.
- Ammonium Persulfate*—In proportional and super-proportional reducer solutions; in Nelson gold toning bath.
- Ammonium Hydroxide*—Accelerator in developing solutions; with hydrogen peroxide as a hypo eliminator; for hypersensitization of negative emulsions.
- Barium Sulfate (Barytes)*—When suspended in gelatin, it forms a mixture known as *Baryta*. This is used as a sizing layer or sub-coating for photographic paper on which the emulsion is coated.
- Borax (Sodium Tetraborate)*—In developers of low activity; in some types of special hardening baths and gold toning solutions.
- Catechol (Pyrocatechin)*—A developing agent giving warm black images; its oxidation products exert tanning effect on gelatin; with caustic soda forms rapid developer giving high contrast.
- Caustic Potash and Caustic Soda*—See *Potassium Hydroxide* and *Sodium Hydroxide*.
- Copper Sulfate*—In copper mordant solutions; in dye toning.
- Diaminophenol Hydrochloride (Amidol)*—A rapid acting developing agent especially suited for lantern slides and transparencies. Requires only sulfite as an accelerator.
- Ferric Ammonium Citrate (Green Scales)*—In iron toning baths for blue tones on papers.
- Ferric Chloride*—Used in etching of zinc and copper.
- Formaldehyde*—As a hardening agent for films and plates used in alkaline solution.
- Glycerin*—Slows drying rate of films and papers; used especially with papers to keep them flexible.
- Glycin*—See *Para-Hydroxy Phenyl Glycin*.
- Gold Chloride*—In gold toning solutions for sepia tones on papers.
- Hydrogen Peroxide*—Used with ammonium hydroxide as a hypo eliminator; in acid solution as a photographic reducer.
- Hydroquinone*—A developing agent commonly used with Elon (*Metol*, *Photol*, *Pictol*, etc.) to make developers for different general purposes; used alone with a caustic alkali accelerator to produce great density with process films and plates.
- Hypo*—See *Sodium Thiosulfate*.
- Iodine*—As a photographic reducer with potassium cyanide.
- Kodalk*—A patented proprietary alkali of the Eastman Kodak Company, having an activity intermediate between sodium carbonate and borax, when used in developers.
- Lead Acetate*—Added in small amounts to developers to prevent sulfide fog; in certain toning and fixing baths.
- Mercuric Chloride*—As a bleaching agent in mercury intensification procedures.
- Methanol*—See *Alcohol, Methyl*.
- Methyl Para-Aminophenol Sulfate (Elon, Metol, Photol, Pictol, Rhodol, Veritol, etc.)*—A well-known developing agent, commonly used with hydroquinone in various combinations to produce "MQ" developers. Builds up image quickly with low fog and stain. See article on *Metol Poisoning*.
- Para-Aminophenol Hydrochloride (Kodilon)*—A developing agent used with carbonate or caustic alkali to produce gray-black images quite free from stain.
- Paraformaldehyde*—As a hardening agent in special developers; liberates formaldehyde in water solution.

CHEMICALS USED IN PHOTOGRAPHY

Para-Hydroxy Phenyl Glycin (Glycin, Athonon)—A developing agent used to limited extent for lantern slides and prints; with para-phenylenediamine as a fine grain developer.

Para-Phenylene Diamine (Base)—A developing agent having very low energy and a slow development rate. Used commonly with metol or with glycin to produce extremely fine grain images. Requires only very weak alkali, such as sulfite, to produce development.

Para-Phenylene Diamine Hydrochloride—Used to a limited extent as a fine grain developer.

Platinum Chloride—In platinum toning baths.

Potassium Bichromate—A sensitizer for gelatin, fish glue, and other similar substances used in photomechanical printing processes. After sensitizing and exposure to light, such substances are insoluble in water. Also used as a bleach for wash-off relief, reversal, and chromium intensification. A constituent of a cleaning solution for trays and tanks.

Potassium Bromide—As the source of bromide in making silver bromide emulsions; in developers as a restrainer of development and chemical fog; in redevelopment as a constituent of the bleach.

Potassium Carbonate—As an accelerator in development; in concentrated solution for removal of excess water from negative films to permit printing at once after washing.

Potassium Chloride—In emulsion manufacture.

Potassium Citrate—In development as a restrainer; in copper toning baths.

Potassium Cyanide—In the wet plate process as a fixing agent; with iodine as a reducer for negatives or prints; with silver nitrate as an intensifier (Monckhoven).

Potassium Ferricyanide—With hypo as a photographic reducer (Farmer); as a bleach before sulfide toning; in dye toning solutions.

Potassium Hydroxide—A strong accelerator in development; to soften gelatin for removal of emulsion from used or old plates.

Potassium Iodide—In the manufacture of emulsions; in the preparation of the mer-

cury iodide intensifier; as a solvent for iodine in various solutions.

Potassium Metabisulfite—In developers as a preservative; to a limited extent in acid fixing baths.

Potassium Oxalate—In the ferrous oxalate developer; in the bleach of the sepia re-developer for minimizing iron stains.

Potassium Permanganate—In acid solution as a photographic reducer; in stain removal; in a hypo test solution; in bleach baths of the reversal process.

Potassium Thiocyanate—See *Sodium Thiocyanate*.

Pyrocatechin—See *Catechol*.

Pyrogallol (Incorrectly described as Pyrogallie Acid)—A well-known developing agent; produces a staining and a tanning effect on gelatin.

Rochelle Salts—See *Sodium Potassium Tartrate*.

Silver Nitrate—An important constituent in emulsion manufacture, as source of silver; used in intensification processes; used in wet plate processes as a sensitizing agent.

Sodium Acetate—In acid hardening fixing baths.

Sodium Bicarbonate—In fixing and toning bath for printing-out papers.

Sodium Bichromate—See *Potassium Bichromate*.

Sodium Bisulfite—In pyro developers as a preservative agent; in acid fixing baths; in clearing baths for the reversal process.

Sodium Bromide—In developers as a restraining agent. Seldom used because of tendency to cake.

Sodium Carbonate—Best known and probably most commonly used alkali or accelerator for development.

Sodium Chloride—In developer as a mild restrainer; in preparation of chloride emulsions; in formulas for printing-out papers.

Sodium Cyanide—Same uses as *Potassium Cyanide*.

Sodium Hydroxide—Same as *Potassium Hydroxide*.

Sodium Metaborate—A mild alkali in developers, intermediate in its activity between borax and carbonate.

Sodium Metabisulfite—Same as *Potassium Metabisulfite*.

Sodium Potassium Tartrate (Rochelle Salts)—

In ferrous oxalate developers acts as a preservative; prevents precipitation of aluminum sludge in fixing baths.

Sodium Sulfate—An anti-swelling agent for use in developers and rinse baths for high temperature development.

Sodium Sulfide—The active agent in sulfide toning; used as a silver precipitant for silver recovery by the sulfide method.

Sodium Sulfite—The most common preservative in developer solutions and acid hardening fixing baths; a blackener for intensification of mercury bleached negatives; an accelerator for development with amidol and with para-phenylene diamine.

Sodium Tetraborate—See *Borax*.

Sodium Thiocyanate—As a solvent of silver halide, it is a constituent of fine grain developers; in mordant solutions for dye toning.

Sodium Thiosulfate (Hypo)—The best known solvent for silver bromide and other silver halides; used almost exclusively in all fixing baths for films, plates, and papers; with ferricyanide in photographic reducers (Farmer).

Sulfuric Acid—See *Acid, Sulfuric*. (Note: When mixing formulas, be sure to put sulfuric and similar acids *into* the water *slowly* and never the water into the acid. This precaution will prevent the possibility of a minor explosion.)

Uranyl (Uranium) Nitrate—For intensification of negatives; in several toning baths for films and prints.

REFERENCES

As this glossary is necessarily brief, further details may be found in the following:

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CHEMISTRY OF PHOTOGRAPHY

Glenn E. Matthews

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Chemistry is the bedrock of photography and its development is inexorably linked with the growth of photography. Here Mr. Matthews reviews the broad aspects of this subject. The nature and purpose of developer constituents. Factors influencing development. Nature and action of the chemicals in a fixing bath. Intensification and reduction of negatives. Toning. History of photographic chemistry. Niepce, Daguerre, Talbot. Evolution of wet plate, dry plate, and roll film. Chemistry of film, plate, and paper manufacture.

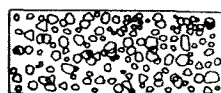
See Also *Baryta, Bromide Papers, Chemicals Used in Photography, Conversion Tables, Developers, Emulsions, Films, Fixing, Formulas, History of Photography*

WHEN A sensitive photographic material is exposed to light, either in the camera or when a print is made, an invisible or *latent* image is produced in the emulsion layer, which can be *developed* to form a visible image of silver. It is possible also to produce a visible image by an exposure of many thousand times that required to produce a latent image. Such emulsions are called *print-out* and a typical example is the gelatino-chloride (with excess silver nitrate) printing-out paper used to a very limited extent for making brownish-red proofs by portrait studios. The majority of photographic materials, however, require development and are *developing-out papers*.

CHEMICALS USED IN PROCESSING

A photographic developer is a solution containing a chemical *reducing agent*, which is capable of reducing the exposed grains of silver bromide (chloride or iodide) to metallic silver. This type of development is called *chemical* and differs from *physical* development wherein the solution itself contains a silver salt which is deposited on the tiny nuclei* of the latent image. (See *Development* and *Physical Development*.) Physical development is used very little, being employed principally by photoengravers and for intensification of negatives.

*When an emulsion is prepared, traces of sulfur compounds in the gelatin react with the silver bromide and form tiny specks of silver sulfide. On exposure to light, a very small amount of metallic silver is deposited around each sulfide speck to form the nucleus of the latent image.



A



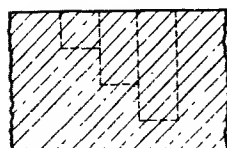
B



C



D



LATENT IMAGE



PARTIALLY DEVELOPED



NORMALLY DEVELOPED



FIXED OUT

THE DEVELOPMENT PROCESS. The black areas in all diagrams represent developed silver. Explained in the text
Photo, Kodak Research Laboratories

In 1863, Major C. Russell found that it was possible to develop an image in collodion dry plates with an alkaline solution of pyrogalllic acid without the addition of a soluble silver salt. When the gelatin dry plate was introduced in about 1875, the full significance of this discovery began to be appreciated. Since that time many types of alkaline developers have been suggested for various kinds of photographic work.

When the exposed sensitive material is placed in the developer, the solution penetrates the gelatin and begins to reduce the exposed grains to metallic silver as shown in sections B and C of the accompanying diagram. As development progresses, the contrast (difference in blackness or density of the darkest and lightest areas) of the image increases as shown by the diagram under sections B and C of the figure. If development is carried too far, the contrast may increase too much and the resulting negative may be difficult to print, or if a print is being developed the image may become too contrasty. Also the developer may reduce some of the unexposed grains, causing a *fog* which tends to spoil delicate shadow or highlight details. Different developers require different times to produce a satisfactory degree of development.

NATURE AND PURPOSE OF DEVELOPER CONSTITUENTS

Practically all of the more commonly used developer formulas contain four essential

ingredients: the developing or reducing agent or agents, the preservative, the activator, and the restrainer.

Developing Agent. There are many hundreds of organic compounds and a more limited number of inorganic substances which have been suggested for use as developing agents. Only a few of these compounds have been used to any extent and only three are in common use. These three are methyl para-aminophenol or metol (known commercially as Elon, Rhodol, Pictol, etc.), hydroquinone, and pyrogallol or pyro. Developers containing pyro tend to oxidize quite rapidly and produce varying amounts of stain in the gelatin layer of the negative. In about 1930 such developers began to lose favor and today pyro developers are not used nearly as much as developers containing metol and hydroquinone, the so-called MQ formulas. Each developing agent when in solution has its own energy characteristic. Metol, for example, starts to develop quickly but slows down considerably with time of development, whereas hydroquinone has much the opposite effect. Other less commonly used developing agents are: para-aminophenol, di-aminophenol, catechol or pyrocatechin, para-phenylene diamine, glycin, chlor-hydroquinone, etc.

Preservative. A preservative agent, usually sodium sulfite and occasionally sodium bisulfite or potassium metabisulfite, is added to prevent the oxidation of the developer by the air. If oxidation is prevented during mix-

ing, storage, and use, the solution will keep and work better. Too much sulfite must not be added or some of the silver halide will be dissolved and the rate of development will be retarded. Sulfite also tends to increase the energy of the developing agents. There are two well-known forms of sodium sulfite, namely, a crystalline form and a dry or desiccated form. The latter is used most commonly in this country whereas the crystal sulfite is used in England. The crystal sulfite, when pure, requires about twice the weight of the dry salt when substituting in a formula.

Activator. Most developing agents do not develop unless an alkali is added to the solution. Three kinds of activator are in common use: caustic alkali, such as sodium hydroxide; carbonated alkali, such as sodium carbonate; and borated alkali, such as borax or sodium borate. Strong alkalis, such as sodium or potassium hydroxide, are often used in developers which are required to give high density and contrast in a short time, as for copying line drawings or halftones. Whereas developers containing a weak alkali, such as borax, work slowly and produce rather low contrast. If an excess alkali is present, the developer will tend to give chemical fog, while if there is a deficiency of alkali, the development rate is retarded. Caustic alkali softens the gelatin layer and swells it, particularly in hot weather, resulting in frilling and blister formations. Higher energy developing agents such as metol, which bring up the image quickly, generally require a lower concentration of alkali than the slower developing agents such as hydroquinone. Sodium carbonate is supplied commercially in three varieties, of which two are crystalline and the third is desiccated. The two crystalline forms are known respectively as the decahydrate and the monohydrate, the former being used in England and the latter to some extent in this country. The desiccated salt is supplied in a very pure form and used quite extensively in the United States. Approximately 2.7 times as much of the decahydrate and about 1.17 times as much monohydrate is required than the desiccated carbonate.

Restrainer. The most commonly used restraining agent is potassium bromide. It

serves a two-fold purpose: (1) to minimize the fogging tendency of the solution or of the film developed therein, and (2) to overcome the effect of overexposure. Modern sensitive emulsions have a lower fogging propensity than those made during the early years of this century. Present-day chemicals are of a high degree of purity. Therefore almost no fog should be obtained provided the developer is mixed correctly and does not become contaminated. Since the bromide in a developer lowers the effective emulsion speed, it is best to keep the bromide concentration low and, if possible, to omit the bromide entirely. Any initial fogging tendency of a developer usually disappears soon after the solution has been used because bromide accumulates in the developer as a by-product of development.

FACTORS INFLUENCING DEVELOPMENT

In general, the degree of development depends on the time of development, the temperature, the degree of agitation, and the activity of the developer with reference to a specific photographic material. Development time varies from about 2 minutes with caustic-hydroquinone developers to 60 minutes or longer with certain physical developers. For many roll films, the time varies from 10 to 25 minutes depending on the contrast desired. Nearly stagnant development requires about twice the time for the same contrast as development with constant agitation. Best results are secured with most photographic materials when the developer temperature is maintained between 65° and 70° F. (18° to 21° C.). With most developers, it is not recommended that they be used above 75° F., unless precautions are taken to prevent swelling of the gelatin by the addition of an anti-swelling agent, usually sodium sulfate. At low temperatures, the rate of development is slowed down and some developing agents hardly develop at all.

With the exception of materials for photomechanical processes, modern negative materials have much finer grain than materials which were made before 1930. Even so, a need exists with some of the present-day films, especially when they are to be enlarged considerably, to reduce the size of the

silver particles as much as possible in the course of development. Much research has been conducted to find developing agents and methods of development which would result in a decrease in normal grain size. Para-phenylene diamine appears to be one of the best developers for this purpose but it has two serious disadvantages. It has a slow rate of development, and it produces skin irritation with certain individuals. Combined with glycine, the rate of development is increased but there is still an appreciable loss in emulsion speed, about 50 per cent. In 1938, an Elon developer containing sodium thiocyanate (a silver salt solvent) was described by Crabtree and Henn, and this was said to produce fine grain equal to that of paraphenylene diamine but also said to be free of its toxic properties and to have a minimum loss of speed.

DESENSITIZATION

A noteworthy addition to development technic is a method known as *desensitization*, which was described first in about 1920. Dilute solutions of dyes are prepared for use as a preliminary bath before development or in limited cases are added to the developer, and when the sensitive material is bathed for about 3 minutes in the desensitizing solution, the sensitivity of the material is reduced sufficiently (even with panchromatic materials) so that development thereafter may be done in a comparatively bright light, usually an orange or yellow-green safelight. The latent image is not weakened by this treatment unless the material is exposed to yellow or red light during desensitization or just previous to development. In this case a bleaching of the latent image sometimes occurs. Several of the best known desensitizers are phenosafranine, pinakryptol green, basic scarlet N, pinakryptol yellow, and pinawhite.

RINSING AND HARDENING BETWEEN DEVELOPMENT AND FIXATION

Negative materials and prints should be rinsed between development and fixation to prevent transfer of the developer to the fixing bath which would contaminate the latter solution and eventually result in the formation of stain on materials fixed therein.

Water is the most commonly used rinse bath and is generally satisfactory if running water is used. A dilute solution of acetic acid, about one per cent, is used extensively for papers and to some extent for negative materials. It has the advantage that it neutralizes the alkaline developer instantly and stops development. In hot weather, negative materials are quite often rinsed and hardened in a 3 per cent solution of potassium chromium sulfate (chrome alum), which hardens or tans the gelatin as well as neutralizes the alkali in the developer. For the most severe tropical conditions, a hardener containing chrome alum and sodium sulfate is used as this prevents swelling and softening of the gelatin. Frequent replacement of these baths is necessary for best results.

NATURE AND ACTION OF THE CHEMICALS IN A FIXING BATH

All the unexposed and undeveloped grains of silver halide remain in the gelatin layer after development. If these are not removed, they will darken slowly on exposure to light and spoil the negative or positive image. The purpose of the fixing bath is to dissolve the silver salts and make the image permanent. Sodium thiosulfate or "hypo" is one of the few chemical substances which will dissolve the salts used in emulsions. In the process of fixation, hypo combines with silver bromide to form soluble complex thiosulfates of silver and sodium, which are removed in washing after fixation.

Besides hypo, a fixing bath usually contains the following: a preservative, an acid, and a hardening agent. The most common preservative is sodium sulfite although sodium bisulfite is used if the hardening agent is omitted. Sulfite helps prevent decomposition of the hypo by the acid—for if it were not present, free sulfur would form, stain the gelatin, and "fade" the silver image to yellow silver sulfide. Acetic acid is included in many acid hardening fixing bath formulas and potassium alum is used as the hardening agent. Certain ratios of these three chemicals must be used for best results, otherwise the acidity may be too high and cause breakdown of the hypo, or too low and cause a reaction between the sulfite and the alum to form a white sludge of aluminum

sulfite which deposits as a scum on the negative or print. The stability of such fixing baths is improved greatly as a result of the inclusion of boric acid in the formula (Russell and Crabtree, 1933). Chrome alum and sulfuric acid are added to hypo and sulfite occasionally to form a fixing bath, but this type of bath loses its hardening properties rapidly with or without use although it is capable of giving excellent hardening when freshly mixed.

The useful life of a fixing bath that has been compounded properly is about one hundred 8 x 10-inch films or one hundred fifty 8 x 10-inch prints per gallon. Negative materials are usually fixed for twice the time required to clear them, and the bath should be used at about 70° F. Papers should be fixed about 10 minutes at 70° F.

Since it is very difficult to remove the last traces of hypo from photographic papers by any known washing procedure, chemical methods of hypo elimination have been suggested. The majority of such methods are unsatisfactory because substances such as thionates which ultimately produce fading are left in the paper. In 1940, a new hypo eliminator was described with which complete elimination can be assured by a relatively simple procedure. The washed print is immersed for about 6 minutes in a dilute solution compounded from two vola-

tile chemicals, hydrogen peroxide and ammonia. This solution oxidizes the hypo to sodium sulfate, which is inert and soluble in water, while any excess eliminator evaporates on drying the print (Crabtree, Eaton, and Muehler).

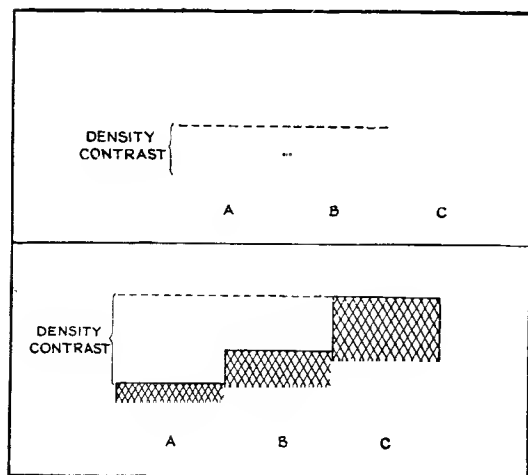
It has also been stated that fading of silver images as a result of external agents (coal gas, hydrogen sulfide, etc.) can be minimized by bathing in a one per cent solution of sodium thionate containing 0.1 gram of gold chloride per liter.

INTENSIFICATION AND REDUCTION OF NEGATIVES

A correctly exposed and developed negative should not need any chemical after treatment. Occasionally negatives are too dense or too thin, or are too contrasty or too flat and can sometimes be improved by treatments known as *intensification* or *reduction*. Every negative should preferably be hardened in an alkaline formalin solution before it is intensified or reduced.

A silver image can be intensified by immersing it in a solution which will deposit a silver, mercury, or chromium compound upon the image. Chromium intensified images are probably the most stable. A satisfactory chromium intensifier consists of a dilute, acidified solution of potassium bichromate. The silver image is bleached with this solution to form silver chloride which is redeveloped in a non-staining developer to yield the intensified image. A useful silver intensifier can be prepared by adding a reducing agent such as metol to an acid solution of silver nitrate. When a silver image is placed in this solution, the precipitated silver particles are deposited preferentially on the silver grains of the image to form a fairly neutral gray rather than a colored, intensified image. Negatives may also be bleached in a bath of mercuric chloride and blackened either in a developer, an ammonia bath, or in a cyanide-silver nitrate solution (Monckhoven).

Photographic reduction consists in the removal of silver by chemical oxidation and should not be confused with true chemical reduction which occurs in the process of development. Photographic reducers may be divided into three types as follows: (1) *Subtractive or cutting reducers* which remove



BEFORE AND AFTER INTENSIFICATION. A silver image can be intensified if placed in a solution which will deposit more silver on the image. The bottom diagram shows the increase in contrast after intensification

CHEMISTRY OF PHOTOGRAPHY

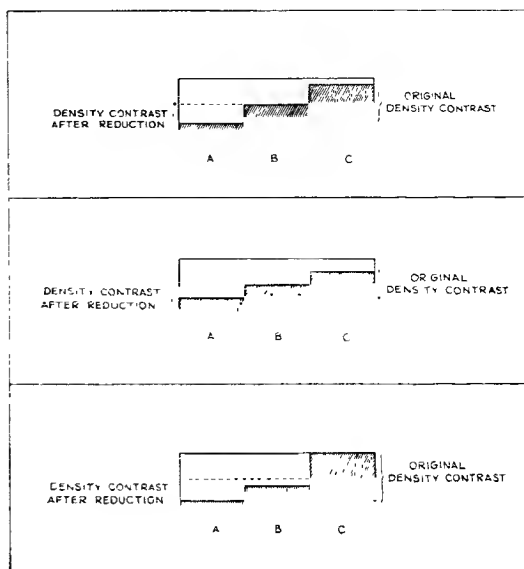
equal amounts of silver from all parts of the image and have the effect of clearing the highlights. Such reducers are useful for improving fogged or overexposed negatives. A typical formula for this work is a 3 per cent hypo solution containing 0.1 per cent potassium ferricyanide. It is called Farmer's reducer. (2) *The proportional reducers* which remove density proportionately to the original density. These reducers lower visual contrast and correct for overdevelopment. One of the best known solutions contains acid permanganate and ammonium persulfate. (3) *Super-proportional reducer* acts very much more on the dense portions than on the light portions of the image. Consequently this type of reducer will reduce the highlights without affecting shadow detail. Only one such reducer is known, namely acid persulfate, and it is rather uncertain in its behavior, being quite sensitive to the presence of impurities, such as iron salts.

TONING PROCESSES

Four principal methods of toning photographic images are used, as follows: (1) toning by direct development, (2) toning by replacement of the silver image by other metals or by inorganic salts of metals, (3) toning with dyes, and (4) toning with color-coupling developers.

The size of the silver particles composing the image determines to a large extent the color of the silver image produced by development. And by modification of the nature of the developer, it is possible to control somewhat the size and hence the color of the image. For example, warm black tones can be produced on lantern slides by using a hydroquinone developer containing caustic soda. Only a limited range of colors is possible by this method, however, and other procedures are used more commonly to obtain slight modifications of color.

Printing-out processes produce, by the action of light, a yellow or yellow-brown silver image (after fixation). Such image can be changed to a more pleasing tone by replacing the silver with gold or platinum. The material containing the image (usually a print) is placed in an alkaline solution of gold chloride, or in an acid solution of potassium chloroplatinite. The rate of the



REDUCTION PROCESS. This shows the change in contrast resulting from various types of reduction. Upper diagram shows proportional reduction; center diagram shows cutting or subtractive reduction; lower diagram shows super-proportional reduction

reaction, particularly with gold toning, is important. If too slow, the metal is deposited in a very fine state. With gold a red tone is produced. If the rate of deposition is more rapid, the deposit is coarser and the color will tend to be blue.

In many of the toning processes based on the use of colored salts of metals, the silver image is transformed into silver ferrocyanide, the silver in the ferrocyanide then being replaced wholly or partially by another metallic ferrocyanide which is colored. For example, blue tones can be produced by treating a silver image with a solution of potassium ferricyanide to which iron citrate or ferric alum has been added. Reddish-brown tones will be obtained with uranium nitrate and potassium ferricyanide, and red tones with cupric citrate plus ferrocyanide. Of course, in each case several other chemicals are necessary to give a practical working bath. Two well-known methods are used for producing silver sulfide images which range from yellow-brown through sepia to warm black. These methods are described as (1) direct toning with a warm hypo bath containing alum and a small amount of silver chloride; and (2) the process

of bleaching and redevelopment. In the latter method the silver image is bleached to silver bromide by immersing it in a ferricyanide solution containing potassium bromide, and then it is treated in a dilute sodium sulfide solution (about 0.1 per cent) which changes the silver bromide to silver sulfide. With the usual hypo-alum bath, toning must be carried to completion or objectionable double tones will be produced. By the addition of ammonium persulfate and gold chloride, the hypo-alum bath is modified so that prints may be removed at any time from the toning bath and varying degrees of uniform sepia tones will be obtained.

Certain inorganic compounds, such as silver ferrocyanide, can be used to mordant basic dyes, and a wide range of colors can be produced. The silver image is immersed in a solution of potassium ferricyanide, uranium nitrate, and oxalic acid which converts the image to silver ferrocyanide plus brown uranyl ferrocyanide. Typical basic dyes which are used in an acetic acid solution to produce the final tones are: Safranin A (red); Chrysoidine (orange); Auramine (yellow); Victoria Green (green); Methylene Blue (blue); Methyl Violet (violet). Double tones (white half-tones and colored shadows) can also be formed by a special iron mordanting bath followed by the dye bath.

Within quite recent years, since 1938, a few papers have been published and one or

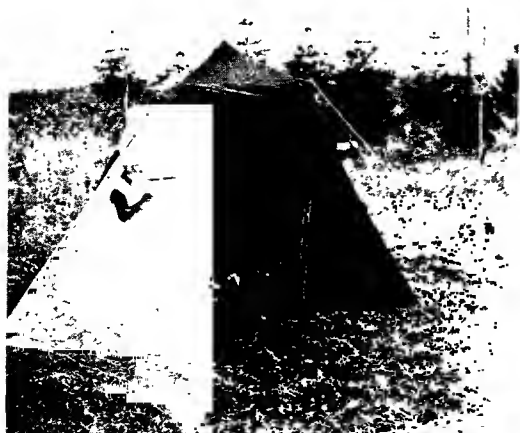
two methods exploited commercially on the use of dye coupler compounds for toning paper prints. When silver bromide is reduced to silver, the developing agent is oxidized and in some cases will combine with other chemicals, known as *couplers*, to form dyes. For example, para-diethylaminoaniline is a typical developing agent. Typical coupling agents are: for cyan tones (blue-green), alpha naphthol or chlor alpha naphthol; for magenta tones, para-nitro phenylacetone; for yellow tones, aceto acetanilide.

HISTORY OF PHOTOGRAPHIC CHEMISTRY

The part that chemistry has played in the development of photography is aptly illustrated by a comparison of the crude, bulky apparatus which was necessary to make pictures by the wet plate process, which flourished between the years 1851 and 1878, and the simple, compact cameras and highly sensitive films in wide use today. When a wet plate photographer started out for a day's picture making with his pack of chemicals, plates, and dark tent on his back, he resembled a prospector more than a cameraman. Of necessity he was his own manufacturing plant. He chemically sensitized his plates just before using, exposed them while wet, and developed them at once. Subsequently he made prints from his negatives on paper which he sensitized himself.

With the introduction of the dry plate and later the film, the crude methods of wet plate photography disappeared, and the preparation of chemicals and sensitive materials became a commercial operation. Today most photographers purchase all their materials from firms who manufacture them in large quantities. As a result of this centralization, the quality of the product is far superior to that which would have been possible by individual effort.

The basic reaction underlying photography is the observation that certain substances undergo a chemical change when exposed to light, in particular the salts of silver. Although silver chloride was known to the early alchemists, it was not until 1727 that a recorded observation is known to have been made of the darkening of a silver salt when exposed to sunlight. In that year a German physician named Schultze prepared



WET PLATE PHOTOGRAPHER. This is the handy equipment necessary for the photographer of the 1870's. The tent was light-tight and was used to mix and apply the emulsion and develop the film
Photo, Eastman Kodak Company

CHEMISTRY OF PHOTOGRAPHY

fugitive copies of stenciled letters with a mixture of silver nitrate and chalk. It does not appear, however, that he had any idea of combining his discovery with the *camera obscura*, which had been described nearly three centuries before in the writings of da Vinci (1452-1519). This union was a necessary one in order to record the images produced with this device but it was not until 1802 that a record is known of experiments of this nature. A paper was published in that year in the *Journal of the Royal Institution* (London) by Wedgwood and Davy which described the copying of paintings on glass and the making of profiles (silhouettes) by the action of light upon paper or leather which had been treated with silver nitrate. The process as carried out had two great drawbacks: first, no means was known of fixing the image to prevent darkening of the unexposed parts of the image; and second, the method was very slow.

A quarter century before the publication of Wedgwood and Davy's paper, the great Swedish chemist, Scheele, had laid the foundation of the photochemistry of silver salts and attributed definitely the darkening of silver chloride to the action of light. He also showed analytically that the substance decomposed to form silver with loss of chlorine. Scheele tested the action of the solar spectrum on paper coated with silver chloride and observed that the violet rays darkened it more rapidly than the red rays but he failed to note the even stronger action of the shorter ultraviolet (invisible) rays. This effect was noted in 1801 by Ritter, who discovered these rays.

The last twenty-five years of the eighteenth century and the early part of the nineteenth century represent a period during which a large number of observations were reported on the chemical activity of light. The study of silver salts was continued by Bergmann, Senebier, and Fulham; changes produced by light on mercury salts were investigated by Bergmann; the bleaching of vegetable dyes by light was observed by de Saussure, Senebier, and others; and the photochemical reaction of iron salts was noted by Döbereiner. In 1798, chromium and chromic acid were discovered by Vauquelin but the light sensitivity of

chromated gelatin was not recorded until 1830 (Suckow). Quite accurately this period has been defined as a natural transition connecting the era of photochemical discovery to that of photographic invention.

NIEPCE, DAGUERRE, AND TALBOT

No more distinguished names are known in the early history of photography than those of the two Frenchmen, Joseph Nicéphore Niepce and Louis Daguerre, and the



JOSEPH NICÉPHORE NIEPCE. Niepce (1765-1833) was the first to obtain a photographic image which was permanent. He collaborated with Daguerre *Photo, Société Française de Photographie*

Englishman, H. Fox Talbot. Each of the first two inventors contributed chemical processes of great significance at the time. Today these methods are practically unknown. On the other hand Talbot's work, which represented a continuation and an improvement on the work of Wedgwood and Davy, established the basis for a process of photography which has carried through to the present time.

Niepce apparently became interested in lithography during the year 1813, when it was introduced in France. He tried to find a



LOUIS JACQUES MANDÉ DAGUERRE. Daguerre (1787-1851) is generally credited with having perfected the photographic process. His invention, the Daguerreotype, was popular until the middle of the last century

Photo, Kodak Research Laboratories

method of imprinting designs on the lithographic stones with the aid of light and thus avoid the laborious task of copying these designs by hand. He experimented with many substances, including silver chloride, but met with little success until 1826 when he tried a pitch known as the "Balm of Judea." This asphaltum becomes insoluble in certain oils after exposure to light. Niepce coated a thin layer of this pitch on a metal plate, exposed it to light behind a line drawing (requiring six to ten hours in sunlight), dissolved away the pitch from the areas which had been protected by the lines, and etched the metal with an acid bath in these areas. To this process, he gave the name *heliogravure*. He also attempted to form images on glass plates coated with asphaltum by exposing them in the camera obscura, which consisted of a small box with a lens on one side forming an image on a sheet of paper or a groundglass on the opposite side. The extreme slowness of the process as well as the lack of contrast and detail in the

resulting image rendered the method of little interest for photographic purposes, although it was of value for photomechanical work and is still in use.

The other Frenchman, Daguerre, was a gifted scene painter who had used the camera obscura for sketching in connection with the making of panoramic paintings called Dioramas. He also experimented with various substances as early as 1824 in an attempt to "fix" the image formed with the camera obscura. In 1827, Daguerre met Niepce and as a result of their mutual interest they signed a ten-year partnership agreement in 1829, which was terminated by the death of Niepce in 1833. This partnership was renewed in 1837 in a commercial way between Daguerre and Isidore Niepce, the son of the former partner. Daguerre began experimenting with silver plates in about 1831 and in 1837 he made the discovery of the process, which later was to bear his name (Daguerreotype) and make it world famous. The process consisted in the exposure of a polished silver plate to the vapors of iodine, resulting in the formation of a silver iodide layer on the surface. When this plate was exposed in the camera for several minutes in full sunlight, the invisible image produced could be made visible, or it could be "developed," by fuming the plate in a closed box with a mercury vapor which adhered to the exposed parts of the plate. Daguerreotype pictures were of beautiful quality and aroused considerable public interest, especially after the process was made public at a formal meeting of the French Academy on August 19, 1839. For about fifteen years, the Daguerreotype process was used throughout the world until it was displaced by a method wherein silver salts were coated on glass rather than metal.*

Like his two French contemporaries, Talbot, an amateur English scientist, became interested in the idea of photography in connection with the camera obscura as an aid to sketching. In about 1833 he began a series of studies. The results of this work were communicated to the Royal Institution

*Charles H. Tremear, who is in charge of the Tintype Gallery at Ford's Greenfield Village at Dearborn, Michigan, is said to be the only Daguerreotypist actively practicing in the United States.

in London on January 25, 1839, by Faraday under the title, "Photogenic Drawing." Shortly afterward a full description of the process was published in the *Philosophical Magazine*. His process called for precipitating silver chloride in and on a paper surface and sensitizing it with an excess of silver nitrate. With an exposure in the camera to sunlight of about an hour, a print-out image was obtained which he made permanent or "fixed" by washing out the excess silver chloride with a solution of common salt or one of potassium bromide or iodide. Advantage was taken, thus, of a reaction of fundamental significance to photography, of the solubility of silver halides in excess of alkaline halide solution. In 1840, Talbot discovered the latent image and used a mixture of silver nitrate and gallic acid to develop it.

Evidence also exists to show that another English experimenter made paper negatives in 1837 by developing them in a silver gallate solution. This was the Reverend J. B. Reade who also is to be credited with the first use

of hypo (hyposulfite of soda—now called sodium thiosulfate) as a fixing agent. Reade was led to this observation probably as a result of reading of the solubility of silver salts in hyposulfite in a paper published by Sir John Herschel in 1819. Herschel is also to be credited with the first use of the term "photography" (unpublished notes—February 17, 1839) and the first use of the word "negative" to describe the reversed tones of light and shade shown by a *calotype*, the name used by Talbot to describe his images on paper. By waxing or oiling his calotypes, Talbot was able to make true copies or *positives* by printing them onto another sheet of sensitized paper. He thus became the first man to make a negative and use it to make a print and it can be said quite fairly that Talbot's invention, therefore, was of much greater consequence than that of Daguerre. It represented the first stage in the real line of photographic development. In his honor this method has been called the *Talbotype* process.

Anyone today can prepare with ordinary precaution a sensitized paper as used for Talbotype by the following procedure:*

Select a close, even-grained paper, and in a subdued light, or preferably under a yellow safelight, brush over one side with a solution of silver nitrate containing 7 grams (110 grains) in 200 cc. (7 oz.) of water. Allow the paper to dry and then immerse it in a solution of potassium iodide, 35 grams (1 $\frac{1}{4}$ oz.) in 500 cc. (16 oz.) of water. In about two or three minutes, the silver should be converted to silver iodide. The paper is then rinsed and dried, and in this condition is relatively insensitive to light. For use, it is brushed over with silver gallo-nitrate, being a solution of silver nitrate (10%) with 1/6 its volume of concentrated acetic acid and an equal volume of a saturated solution of gallic acid. The paper may be used wet or kept dry for future use. In either case, after exposure, the picture is developed by brushing some more of the silver gallo-nitrate solution over the surface. It is then washed and the excess silver halide fixed out by a strong solution of hypo (sodium thiosulfate).

WILLIAM HENRY FOX TALBOT. Talbot (1800-1877) worked, unlike Daguerre and Niepce, on the positive-negative theory. His calotype or Talbotype process used a sensitized and waxed paper as a negative

*From "The Chemistry of Photography" by S. E. Sheppard, *Journal of Chemical Education*, Vol. 4, 298 et seq., March, 1927.

EVOLUTION OF THE WET PLATE AND THE DRY PLATE

In Talbot's process, the paper served both as a mechanical support and a binding medium for the insoluble silver salt. An advance over this method was made when a nephew of Niepce (N. de Saint-Victor) coated a glass plate with albumen containing iodide, dried it, and then sensitized it with silver nitrate. The plate was exposed while wet and developed with gallic acid. Various modifications were made in this process and later, about 1850, Blanquart-Evrard introduced albumen paper which became one of the most used materials for making prints, until it was displaced in part by a collodio-chloride paper suggested by Sir William Abney in 1881 and marketed in about 1886.

The wet collodion process of negative making of F. Scott Archer was described in *The Chemist* (London) in 1851. It represented the next important chemical advance after the albumen process, and, in spite of several limitations, is still used today by photo-engravers. Collodion, a solution of nitro-cotton in alcohol and ether (Maynard, 1847), containing a soluble iodide usually with a little bromide, was poured over a glass plate and the excess drained off so as to leave a thin coating after the ether and alcohol evaporated. It was sensitized by immersing the plate in a solution of silver nitrate (about 8%) which precipitated silver iodide plus some bromide in the collodion film. Exposure in the camera was made while wet and development was done by pouring on a mixture of acetic acid and pyrogallol (replaced later by ferrous sulfate and acetic acid). It was fixed with a strong solution of hypo for which a potassium cyanide solution (about 2%) was substituted later and is still used.

With such plates, the exposure time was reduced from a few minutes to a few seconds and negatives or positives of fine quality were obtained, but the process of preparation was messy and cumbersome and many attempts were made to improve upon it, one of which led to the development of a dry collodion plate. This was obtained by precipitating the silver iodide in a finely divided form in the collodion before coating, but the resulting plate usually did not have quite the sensitivity of the wet plate.

A fundamental contribution was made by Major C. Russell in 1863. He washed the silver nitrate out of a dry collodion plate, hardened it with tannin, and developed it with alkaline pyrogallol. The full import of this step was not realized at the time, but it later proved to be a significant contributing factor in the success of the gelatin dry plate and film process.

According to Sheppard, "The modern industry of photography only became possible with the introduction of gelatin as the suspending medium for the silver salt, made by Dr. R. L. Maddox of Liverpool in 1871." Maddox followed the practice of collodion and used unwashed emulsions containing an excess of silver salts. Shortly afterwards, this procedure was changed and it became customary to wash the shreds of gelatin emulsion in cool water to remove the soluble salts of silver. J. Burgess initiated the sale of manufactured dry gelatin emulsions made from a secret formula in 1873. R. Kennett prepared dry emulsion for sale under the name *sensitive pellicle* and in 1874 he sold dry gelatin silver bromide plates. Gradual improvement was noted in the method of preparation of gelatin dry plates and in their sensitivity and in 1878, C. Bennett published his method of *ripening* an emulsion by heating it in the presence of an excess of potassium bromide. This process came into quite general use by the British plate manufacturers whereas the German manufacturers preferred a digestion method which required lower temperatures and the use of ammonia. Special gelatins for photography were produced. Dry plates were introduced by several firms about the year 1877, but it took photographers nearly five years to become accustomed to the increased speed of these plates which was about ten times that of wet plates.

No exact date can be given to establish the beginning of commercial manufacture of photographic materials as an industry, but progress in design of equipment for making emulsions and coating them on plates was rapid after the introduction of the dry plate in 1877. Steam kettles were adopted for melting and ripening the emulsion, hydraulic presses were used for shredding it, and coating machines for applying it, in a layer of

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controlled thickness, to the plate. Such firms as Edwards & Company, Wratten & Wainwright, Cadett & Neall, Anthony-Scovill, Eastman Dry Plate Company, and others began to manufacture and to advertise in the photographic literature of that day.

THE ROLL FILM

George Eastman began the commercial manufacture of dry plates bearing his own name in 1880 in Rochester, New York. Early in 1879, he had made dry plates of good quality and during that year he invented a mechanical plate-coating machine which he patented. In 1883-1884 he conceived and began to work out a new system of photography now known as the *roll film system*. As first devised, this method consisted in coating a long strip of paper with a sensitive emulsion, slitting the paper into narrow strips, and winding these onto rollers or spools. These spools were inserted into a roll holder which could be attached to the back of a camera in the position of the plate holder. After each exposure was made, the film was wound sufficiently onto another spool to bring an unexposed portion into the plane behind the lens. Paper grain sometimes appeared in the print made from such paper negatives and a "stripping film" was developed by Eastman as an improvement. This film had a temporary paper base coated with soluble gelatin over which the gelatin emulsion was coated. Subsequent to exposure and development, this film was placed

emulsion side down on a glass sheet, softened with water, and the paper base stripped away. Stripping film was patented in 1884 and used in the first "Kodak" in 1888, which accommodated a length of film sufficient to make one hundred exposures, each $2\frac{1}{2}$ inches in diameter.

Eastman was not satisfied, however, with a process that required a stripping operation onto glass to produce a negative for printing. With the aid of a trained chemist, he started work in August, 1886, on the problem of finding a suitable transparent support. Promising results were obtained in December, 1888, and on April 9, 1889, a patent was applied for on a method of making a transparent, flexible support. The method consisted in dissolving nitrocellulose in wood alcohol and adding a mixture of camphor, amyl acetate, and fusel oil. The cellulose nitrate solution was flowed onto long glass tables, allowed to dry, coated with a *substratum* of sodium silicate to insure adherence of the emulsion, and then coated with the gelatin emulsion. After the emulsion had dried, the film was cut into various widths and wound on spools.

Eastman's invention of flexible film changed the basic conditions of photography profoundly. Whereas previously photographers often did their processing and prepared their own sensitive materials, the new generation who used roll film cameras were concerned chiefly with making pictures and not in the details of development and printing.



COATING APPARATUS. The old and the new in photographic equipment manufacture. At the left is the old glass table surface on which the film support used to be coated. And at the right is the new machinery showing roll wind-up end

Photo, Eastman Kodak Company

CHEMISTRY OF MODERN FILM
MANUFACTURE

In the manufacture of sensitized photographic materials, absolute cleanliness is very necessary at every stage of the process. All operations must be conducted in dust-free rooms, which are maintained at a uniform temperature throughout the year. Chemicals of a high degree of purity are used in the preparation of the two principal constituents of film, the *base or film support*, and the *light-sensitive emulsion*.

The Film Support. Two general types of support are manufactured, namely, cellulose nitrate which is quite inflammable, and cellulose acetate, the slow-burning safety film. Since about 1925, the quantity of the latter film has been increasing steadily.

Cotton linters (short fibers) are the source of cellulose for both types of film support. The cotton is washed and bleached very thoroughly to prepare it for nitration. It is dried to a uniform moisture content and then treated under accurately controlled conditions with a mixture of nitric and sulfuric acids. A typical nitrating mixture will consist of 61.9% sulfuric acid, 22.4% nitric acid, and 15.7% water (Clément and Rivière). For 280 grams of cotton, 10 kilograms of solution are used. The temperature of the reaction mixture would be kept at about 40° C. and the complete reaction would require about 15 minutes with a yield of *cellulose nitrate* having a nitrogen content of approximately 12%. The product is centrifuged and washed thoroughly to remove all traces of free acid. It is then pressed into cakes and stored in a comparatively wet condition until it is ready for coating. Then the balance of the water is removed with alcohol, prior to solution in suitable organic solvents, for the preparation of the viscose coating liquid known as "dope."

For the preparation of *cellulose acetate*, the washed cotton linters are treated for many hours in a mixing machine with a solution containing acetic acid, acetic anhydride (strongest form of acetic acid), and sulfuric acid. According to Ulmann, a typical mixture is the following: cellulose, 20 kilograms; acetic anhydride, 70 kilograms; glacial acetic acid, 70 kilograms. About 2 kilograms of

sulfuric acid (66° Bé.) are added in small quantities at a time, the mixture being cooled to room temperature. When the reaction is completed, the acetyl content is reduced by hydrolysis, the thick solution is poured into water and the product, cellulose acetate, separates out as a white amorphous mass. This is centrifuged, washed thoroughly, dried, and ground up preliminary to being redissolved before coating. Cellulose acetate is not highly inflammable like cellulose nitrate, and therefore it can be dried and stored in the dry form, whereas the nitrate must be kept moist.

Film Dopes. Many thousands of patents have been issued for various compositions and solvents for film "dopes" for use in the manufacture of film support. Some of these have been studied extensively, such as cellulose nitroacetate, acetate-propionate, acetate-butyrate, acetate-stearate, cellulose xanthogenate, etc. Cellulose ethers, synthetic resins, casein, and gelatin have been investigated but all possess certain disadvantages.

The preparation of the final coating solution, both for an acetate or a nitrate film support involves three steps: (1) selection of suitable solvents some of which will dissolve the cellulose derivative quickly and completely and others which control the rate of removal of solvents during drying of the coated support; (2) the addition of substances known as *plasticizers* to give elasticity and flexibility to the support; (3) efficient filtration of the "dope" to remove all traces of dirt to ensure the highest clarity possible in the finished product.

Solvent mixtures for nitrate may consist of ethyl or methyl alcohol with acetone or ether to which is added a solvent to slow down the drying rate, such as amyl acetate, butyl alcohol, or amyl alcohol. The most commonly used plasticizer is camphor which is added usually in the order of 10 to 20% of the weight of the nitro-cellulose. Other plasticizers are castor oil, triphenyl- and tricresyl phosphates.

The range of solvents for cellulose acetate is more limited than with nitrate, but acetone is, perhaps, most commonly used. A non-solvent for acetate, such as alcohol and water, is usually added to reduce the rate of evaporation of the acetone or other solvent

when the support is coated. Typical plasticizers for acetate are triphenyl- and tricresyl phosphates. The choice of materials for such purposes is limited because these substances must not have any deleterious effect on the sensitive emulsion with which the support is subsequently to be coated.

Coating. After filtration of the viscose solution of film "dope" under pressure and the removal of air bubbles, the solution is ready for coating. Large complex machines are used commercially for coating film support. In these machines, the dope solution is flowed onto a highly polished and flawless metallic surface (silver, nickel, chromium, etc.) under conditions so arranged that the thin, transparent film may be stripped off within a short time, cured during passage over a series of heated drums, and wound into rolls for emulsion coating. In general, two types of continuous machines for film support manufacture have been employed, those using an endless metal band supported between and driven by two metal drums, and those using a metal drum or wheel of large diameter driven about an axle, by wheels, or rollers. Such machines are enclosed completely to permit the evaporated solvents to be recovered and to maintain cleanliness. Drum machines produce support of various widths up to nearly 60 inches and 2,000 feet long. The same types of machines are used both for nitrate and acetate support although conditions of coating are varied in accordance with the nature of the product. The thickness of the support varies according to the viscosity of the dope solution, the adjustment of the feeding spreader, and the rate of drum rotation. Depending on the purpose or use, the thickness varies from about 0.008 to 0.003 inch.

Before the film support is wound up on the coating machine, it is usually coated with a substratum to insure maximum adherence of the emulsion to the support when dry and in the various processing solutions in which the film is treated. An example of a substratum is a solution of gelatin in water containing a small amount of an organic solvent for the support, such as alcohol or acetone. The substratum is applied to one or both sides of the support with extreme care to insure uniformity and purity.

It is also quite common practice to apply antihalation coatings or special tints to the film support while it is on the machine. For this purpose an organic solvent containing a limited quantity of cellulose ester and the dye may be used.

THE SENSITIVE EMULSION

Emulsion Manufacture. For nearly three-quarters of a century, gelatin has been used as the medium for the suspension of silver salts in the manufacture of photographic emulsions. Clippings from the skins of calves are used as the chief source of gelatin. The clippings are washed and then soaked in lime water for a long time to remove the hair and fat. A long washing with dilute acid and then with water removes the lime.

Next the material is cooked in steam kettles to extract the gelatin, the extract is concentrated and settles to a jelly. The blocks of jelly are then sliced up and the strips of gelatin are dried upon nets.

Some gelatins produce very sensitive emulsions while other samples, even with prolonged extraction, are unsatisfactory for use. The presence of a sensitizing substance in certain types of gelatins was proven by Sheppard in 1925 when he showed this to be mustard oil, which contains sulfur. During manufacture of the gelatin, the sulfur compound is believed to decompose to form tiny specks of silver sulfide, which later act as nuclei of sensitivity in the silver bromide crystal. (See "The Science of Photography" in the article *The Growth of Photography in the Twentieth Century*, Page 9.)

In making silver bromide, the first step is to dissolve pure silver bullion in nitric acid, and after crystallization by evaporation, plate-like crystals of silver nitrate are formed. These are dried carefully and stored in dark bottles until ready for use.

Three salts, sodium or potassium chloride, bromide, and iodide are used in the manufacture of sensitive emulsions. These salts are called *halides*. When a solution of silver nitrate in water is added to a solution of any one of these three salts, a light-sensitive silver salt is produced, which is extremely insoluble in water. It will settle to the bottom of the vessel in a water medium but will remain in suspension in a gelatin solu-

tion. Of the three silver halides, silver bromide possesses the maximum sensitivity to light, silver iodide next, and silver chloride the least. In general, mixtures of two of these salts, such as chloro-bromide, chloro-iodide, and bromo-iodide generally have a sensitivity to light intermediate between the sensitivities of the two components. However, in the case of a bromo-iodide emulsion with increasing quantities of iodide to about 6%, the light sensitivity increases considerably over that of a pure bromide and with further quantities of iodide, it falls again.

The actual preparation of photographic emulsions is a complicated procedure and fits in the realm of manufacturing processes which are regarded as the private property of the firms in this field. Nevertheless, the broad principles of emulsion making are generally well known and may be described as follows: A solution of gelatin of known characteristics is prepared and to this is added the right quantity of one or more sodium or potassium halides. The mixture is placed in a water-jacketed kettle and stirred mechanically while it is held at a very even temperature. The necessary quantity of silver nitrate solution is brought to a predetermined temperature and then run into the gelatin-halide mixture at a definite rate. A milky precipitate of light-sensitive silver salts is produced. A further quantity of gelatin solution is usually added after the precipitation of the silver halides is completed, and then the mixture is maintained for a definite time at a moderately high temperature to permit an increase in light sensitivity by digestion. At the conclusion of the digestion period, the emulsion is cooled rapidly and allowed to set. All of these operations starting with the addition of the silver nitrate are conducted in darkness or under a suitable safelight, usually red or green.

At this stage, the emulsion contains an excess of potassium or sodium nitrate and potassium bromide. To remove these salts, the emulsion is shredded into long round strands in a hydraulic press and the strands are washed for several hours in running water until all the soluble salts are washed away. Excess water is drained off, the emulsion is re-melted, and a final addition of

gelatin is made. Another digestion treatment is carried out which results in a very marked increase in the sensitivity of the emulsion. During this digestion period and the previous one, the size and the nature of the crystals of the sensitive silver salts is changed and the photographic properties of the emulsion are controlled. An important phase of emulsion making is the production of the desired range of crystal sizes in an emulsion.

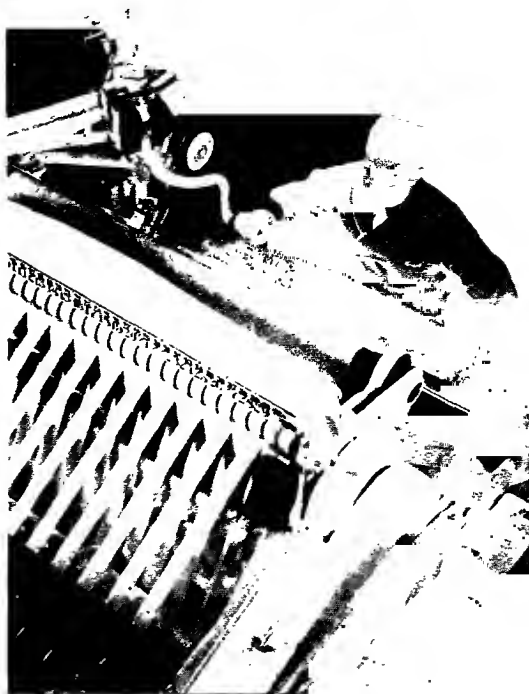
After the addition of small quantities of physical hardening agents, special substances to ensure satisfactory coating, and usually certain dyes (to increase its sensitivity to light or radiation other than ultraviolet, violet, and blue to which the silver bromide alone is sensitive), the emulsion is ready for application to the film support. Great progress has been made since 1930 in our knowledge of sensitizing dyes until it is possible now to sensitize emulsions selectively to all parts of the visible spectrum from violet to the extreme red and even far into the infrared. (See discussion "Color Sensitizing of Photographic Materials" in the article *The Growth of Photography in the Twentieth Century*, Page 7.)

Emulsion Coating. Preliminary to coating, the emulsion is taken from cold storage, melted in kettles, and given a final filtration. The film support is handled in rolls several hundred to 2,000 feet long and varying in width from 20 to 60 inches. The melted emulsion is fed by gravity to the coating machine where the support is drawn over several rollers, one of which dips into a trough of emulsion, or is in contact with an application roller which dips into the emulsion. The level of the emulsion in the coating pan is controlled automatically and the temperature of the emulsion is maintained constant. The coated film passes through a chilling box or around a chilled cylinder after it leaves the coating roller. Before the film has moved very far, the emulsion sets and the film is fed mechanically on long rods which carry it through the drying alley in the form of loops, about eight feet deep. Time, temperature, and humidity of drying play an important part in determining the sensitometric characteristics of the film. Filtered air must be used for drying. Great care

is taken during the coating and drying of film to avoid the production of static electricity which fogs the film and produces tree-like markings that show up when the film is developed. When the film has assumed the correct moisture content, it is wound into rolls, and subsequently slit and cut into various sizes for packing in boxes for shipment.

Multiple Coating. Many films carry more than one coating, either on one or both sides of the support. With certain types of double-coated films, the lower emulsion is capable of giving an image of high contrast whereas the upper one gives low contrast and is a fast emulsion. Increased exposure latitude usually results from double coating. One of the most complex multiple-coated films is the type used in the Kodachrome process of color photography. Three emulsions are coated on one side of the base and are separated by gelatin intercoatings and, with the antihalation backing, make a total of six coatings. It is said to be possible to coat an emulsion layer only 0.0002 inch thick and of such uniformity that no thickness variation effects can be detected photographically. X-ray films are emulsion-coated on both sides, and may, also, be overcoated with gelatin. The film support for X-ray film is usually dyed blue to permit easier inspection of such films. The NC or non-curling roll film has a layer of gelatin on the opposite side from the emulsion to counteract the curling tendency of the film after development. Antihalation coatings sometimes serve as non-curling coatings. Red dyes are used for antihalation coatings or orthochromatic films, green dyes or dye mixtures for panchromatic emulsions, and a few inorganic substances such as manganese dioxide, which have been used on the back as well as between the emulsion and the base. Dyes used for antihalation backings usually have the property of bleaching in one of the processing solutions, such as the developer.

Film support having low shrinkage properties produced by special treatment during manufacture is used for films for mapping and topographic survey purposes where dimensional changes must be kept to a minimum. Supports of this type having a white



FILM SLITTING MACHINE. This shows the wide roll of film being cut into narrow widths and being rolled onto large spools
Photo, Eastman Kodak Company

pigment incorporated in them are used instead of paper for special purposes where low shrinkage is required.

MANUFACTURE OF PHOTOGRAPHIC PLATES

Glass for photographic plates is selected for flatness and freedom from defects. It is cleaned in mechanical scrubbers with an alkali solution, washed with water, and then coated with thin substratum of gelatin or sodium silicate. Similar emulsions to those used for film are used for plates. After drying, the emulsion is applied in a machine having a belt which holds the plates while they pass under an emulsion spreader. From the coating belt, the plates pass onto a chilling belt. When the emulsion has set, the plates are lifted off and placed on racks to dry in a room having controlled temperature and humidity. After an inspection, the plates are cut to size and boxed for shipment. Glass photographic plates are particularly used for photoengraving and scientific work and, for that reason, manufacture must be particularly accurate.

MANUFACTURE OF PHOTOGRAPHIC PAPER

A very high grade paper is used for photographic paper. It is made either from cotton rag or more commonly now from wood pulp. A layer of baryta or barium sulfate held in gelatin is applied first to prevent the emulsion from penetrating the paper fibers and to give a clean, white surface to the paper. The coating of paper is done in a manner very similar to the coating of film, by passing the paper under a roller which dips into a trough of emulsion. After this it travels in loops down through the drying room and is wound up in rolls.

Photographic emulsions for papers are of two general types, bromide and chloride. In a bromide emulsion, the extra salt is removed by washing. This emulsion is used for enlargement papers and, to a limited extent, for papers for contact prints. In general contact papers are coated with emulsions containing silver chloride which is not washed to remove the nitrate. Surfaces are varied by changes in the baryta coating, or by the addition of substances such as starch to the emulsion. (See *Bromide Papers*.)

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CHILD PHOTOGRAPHY

Judith Russell Webster

Specialist in Child Photography

Similar in many respects to Baby Photography, Child Photography has special problems all its own. Judith Webster has proven that it is a field in which women photographers can excel. Included in the article are words of wisdom on posing, backgrounds, and—of course—lighting, next to an understanding of children the most important factor in child photography.

See Also *Baby Pictures, Lighting in Portrait Photography, Portraiture*

WANT A sure formula for successful pictures?

Well, here it is—shoot the children! Nothing deadly intended of course. It's just a reminder that youngsters make the best possible models for your camera—whether it's a 98c special or a \$500 custom-built job.

I don't know how many times I've seen people exclaim enthusiastically over a very ordinary snapshot of a cute child—a picture that had nothing to recommend it other than the fact that the subject matter was good. There were plenty of mistakes that

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were obvious to me, yet the photos drew acclaim from the folks who saw them. This isn't an argument for being careless with your camera. Rather let me recommend

that you take advantage of the wonderful possibilities of the younger generation as performers in front of your lens. As to the mistakes you're likely to make, I think we



AT THE BEACH. Backlighting, a low angle, and action make this picture a good one. Notice the halo effect around the head and the interesting pose of the outstretched fingers
Photo, Judith Russell Webster

can clear up most of them in the next few pages, and pass along a few new ideas at the same time.

So if you're seeking new and better pictures, remember that children call for cameras!

In comparison to babies, children are difficult to photograph because they are more agile and have minds of their own. On the other hand they *can* respond to a certain amount of instruction, provided that it is intelligently given. So the first equipment necessary for child photography is a love for and understanding of children. If you don't have these, no amount of fancy camera or lighting equipment will replace them.

Posing is the biggest problem and the most fun where children are concerned. They're great little actors, but you'll have to realize that you can't pose them with a suggestion like . . . "look over this way," . . . or . . . "just a little smile now." That's almost always certain to turn them into statue-like images. I've found the best way to handle them is to play a game or tell a story. When you have them doing something, they'll put Barrymore to shame with their expressions. All you have to do is snap the shutter at the right moment. Watch for the precise instant when the expression is at its peak before shooting.

OUTDOOR LIGHTING

Outdoors is the most popular locale for photographing children, because of the variety of backgrounds on every hand. Besides that, old Sol is around to furnish illumination, eliminating the cost and possible confusion of arranging lights. But from those very advantages spring our initial pair of problems.

Let's consider the lighting first of all. Since the sun can't be swung around into place for the best results, you'll have to give an extra thought to 1) placing the subject and 2) time of shooting.

We will automatically rule out the hours just before and after noon, because the sun is high overhead and it casts dark shadows that black out the eyes and neck. Early morning and late afternoon are far better, because then the sun is in a low position so

its rays will outline the face and give a sparkle to the eyes.

For really good results, you'll say goodbye to the old rule of "keep the sun behind the camera." Sidelighting or backlighting outdoors is necessary if you want depth and dimension in the shot. Figure the exposure for the face, and don't worry about the highlights. That's an old rule that still holds good. However, if you find that there's too much contrast between the subject and the brightly lighted background, a reflector (made of a white towel or tinfoil-covered board) will put additional light onto the face and equalize the illumination. More convenient than that is the use of a flashbulb to soften the shadows a bit.

There is no trick to using flash outdoors and it offers you the golden opportunity of getting many pictures you've had to pass by. Perhaps the easiest way to figure exposure is to take a meter reading of the reflected sunlight from a shoulder or off the hair. Then, using your standard flash exposure speed (probably 1/100 or 1/200 second), calculate the proper lens setting entirely disregarding the flash. This method is applicable when you stand five feet or more away from your subject. When you are closer, the exposure must be adjusted to the flashbulb — the usual setting being that called for by the flashbulb, disregarding the sunlight.

You control the intensity of the flash on the subject by your distance from it. This procedure will solve your problems and be a vital aid to you, until experience has made the whole thing second nature.

OUTDOOR BACKGROUNDS

When I mentioned the variety of backgrounds you'll discover outdoors, I fully realized that many people have a knack of picking the wrong ones. You'll save time by picking the location ahead of time.

For all pictures, avoid as you would the plague an unsightly side of the house or a colonnade on the front porch. Beware a position on the front lawn where the sidewalk and street will clutter up the distant view. In the backyard, clotheslines and garage doors are always a menace.

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(Continued)

If you plan a straight picture where no action is shown, the background ought to be neutral, something like a hedge or a large shrub, or perhaps a plain wall enhanced by shadow patterns that fall across it. Don't overlook the possibilities of the park on a quiet day. The lake, trees, and flowers make a perfect setting.

When the youngster is caught in the midst of play or work, the background is not so important. He may be leaving the house, playing in the sandpile, or picking up toys, and the background will naturally fit the action. Never let it become too confused, however. In the enlargement, crop out all unnecessary detail. The accompanying photograph shows an extremely cluttered and confused background.

If fate seems to be deliberately putting obstacles in your path, try lowering the camera until the troublesome background disappears and the subject stands out

against the sky. That's an ideal arrangement for an outdoor portrait. Slip a yellow filter over the lens to keep the sky tone dark and so emphasize the subject. An example of that technic is illustrated. The boy sitting on the low wall is in a perfect spot for a picture. But at normal height, the camera reveals the houses and electric



LOW ANGLE SHOT. Watch for concrete bulkheads and convenient walls if the beach is crowded and you want the subject alone in the picture. And it helps, too, to have someone play a game with the child so that he won't be too aware of the camera
Photo, Judith Russell Webster



COMPOSITE OF MISTAKES. This remarkable photograph has almost everything wrong with it—except perhaps the exposure. The child is right in the middle of the picture, self-conscious, and squinting into the sun. The foreground and background are cluttered
Photo, Judith Russell Webster

poles down the block. It's simple to lower it and eliminate them completely. That's a good point to keep in mind. Or you may reverse that system, to stand atop a convenient bench and shoot down on the child. A third good trick is to throw a muddled background out of focus by opening the lens wide and compensating for the exposure with a faster shutter speed. Since this decreases the depth of field, you'll need to focus carefully so the subject will be sharp.

This matter deserves a lot of thought before you click the shutter, and you should remember that even if you can forget the



HIGH ANGLE SHOT. If the low angle is impossible, it is an interesting variation to take the child against the ground (or beach) as a background. The mother of this child had said that a good picture of him had never been taken!

Photo, Judith Russell Webster

background, the camera cannot. (See article on *Backgrounds and Foregrounds*.)

CAMERA ANGLES

The shooting angle is an important factor in good child pictures, aside from its help in overcoming background problems. A low angle gives a feeling of freedom and fun or a dramatization of whatever mood may prevail at the moment. And I love the simplicity of pictures shot against the sky—they're so striking. In picking the position, make certain that any move on the part of the subject will not result in distortion.

Looking down on a group of youngsters at play gives an impression that a straight-on shot can never achieve. An overhead position is grand for the sandpile or play yard, where it can show the child in the midst of his toys. When you're all set, have someone call from the side, so he'll raise his head and you can catch a glimpse of the face.

Around the house and at the park, watch for opportunities to frame the scene with atmospheric material. Poke the lens through

a trellis or between fence pickets, or let it peer through a fern leaf to show the children at play on the bank of a stream. The camera should be far enough from the framing material so that the foreground will retain its distinctive shape.

ACTION SHOTS AND PORTRAITS

There are two ways to photograph children, and you have to decide which you want before arranging the pose. One is the *action shot* where you catch the youngster playing with a favorite toy, digging in the sandpile, or trying out a new tricycle. The other is a *portrait*, formal or informal.

If you choose an action shot, arrange the setting before the child appears so that you don't tire him by fussing about. Decide how the sun should strike him and where you ought to shoot from. Then maneuver him into place with as little reference to the equipment as possible. A remark like . . . "now Johnny, turn this way a little so you can see the wagon," is a pretty good approach. You have to solve your technical problems and translate your wishes into playground talk. When you begin, a running fire of natural questions about his toys or what he has been doing will keep up his interest. If the mother is tipped off in advance, she can be a big help in attracting his attention for you. I like shots which give the feeling that the camera peeked in on a child at play.

The portrait outdoors can be made with or without the assistance of toys. In the close-ups they won't show anyway. Here the most important thing is to talk to your subject and get him to talk to you. I'll never forget the two-year-old who was completely disinterested in the proceedings until I asked if he knew the story of Red Riding Hood. You bet he did! And he rattled off the fastest double-talk version of the affair I've ever heard! I've since wished that it had been recorded, but it did give me a couple of excellent shots while he tripped and stumbled over the words in his haste to tell me all about it.

INDOOR LIGHTING

Inside the house things are different. The matter of lighting is our first consideration

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now. Of course we can use the sun slightly, by letting the child sit in the window as the sun streams in. Light for the shadows is then provided by a white towel or tablecloth reflector.

Window shots are all right but we can do far better by closing the curtains and using electric lights exclusively, for that gives us complete control over the illumination. The new fast films in all camera sizes are making action snaps indoors a simple matter now. But if the results are to resemble those enticing ads, we'll have to do more than stick a couple of photoflood bulbs in reflectors and hang them on the nearest doors.

The beginner's chief mistake is the idea that he should take a couple or three floodlights and turn them on the subject, just to be sure there's plenty of light. It arises

from the fact that he doesn't realize that the purpose of the light is to help capture the character of the subject. That is why you begin with *just one light*. It is the key light, used to furnish the general illumination, which is the key to the final picture.

We place the key light to one side of the camera, usually a foot or two above the subject's eye level. That is so it will give depth and roundness to the face, with highlights and shadows caused by the plumpness of a cheek, the recession of an eye, the cut of a young chin. If you haven't used lights in this way before, try the simple experiment of setting your subject in an easy chair, and turning out all lights except a single floor lamp. Then move it slowly from side to side, now close, now farther away. Step back frequently to study the results. Notice how the appearance of the



THE GANG. This photograph of four boys is sure-fire. When possible, take a good many child photos outdoors in the sun—for that is where children belong. And angle shots are very useful when distracting backgrounds are to be eliminated
Photo, Torkel Korling



LIGHTING SET-UP. This shows the author in the act of shooting a child picture. The spot on the mantel to the right is the key light. The light at the rear, equipped with a "snoot," gives the catchlights across the hair, cheek, and shoulder. The spot to the left of the author serves as a fill light, to soften shadows on the face

face changes with each movement. That is the basic principle of all photographic lighting, and once you understand it, you are well on the road to achieving good pictures.

When that key light is in position, try a second light from behind and to one side, shining across the shoulder and adding depth to the picture. Set rather high and to one side, it also adds catchlights to the hair and on the cheek. Be sure however that it doesn't glare into the lens.

Frequently it's helpful to direct a light onto the background, or to place a light beside the camera as a "fill" light, to soften the shadows. But don't get too many lights strung around because they'll just make it easier for you to trip over the cords and they make the child self-conscious. Keep things as simple as possible.

The lighting set-up as I have described it can be worked with No. 1 or No. 2 photoflood bulbs. Be sure to put them in reflectors or a convenient floor lamp, so

their rays won't strike the camera lens. They are inexpensive and furnish plenty of light for fast shooting.

But the one thing that photoflood bulbs don't give is a crisp, sparkling picture. Their illumination is diffused and general. You can't produce sharp shadows, or keep one portion of the picture in a darker tone. That's the reason I made several experiments with the small (100-150 watt) portable spotlights as soon as they came on the market. When I'd finished, I bought three of them. Using a trio of spotlights I can light practically any scene and still shoot fast enough to stop action. Best of all, their light is so completely controlled that it goes just where you want it. They don't glare into young eyes or heat up the room as the floodlights do. And besides, they're perfectly safe.

As to further equipment, a long extension cord with a triple socket on the end will soon pay its way in the elimination of headaches that arise when you look for extra wall plugs. After weeks of clamping reflectors on flimsy bridge lamps and inconvenient doors, I finally picked up a set of old music racks. With the tops removed, they make ideal light stands.

One spotlight set at "flood" stage for the fullest illumination provides my key light. Used from 4 to 5 feet from the subject, it is intense enough for shooting at 1/100 second, f/3.5 on Superpan Press film. Once it is in position, I arrange a second spot, on a very tall stand, as a backlight. It is adjusted to the "spotlight" stage, so as to produce a bright catchlight in the hair or across the shoulder. If the youngster has deep-set features, I usually employ the third spot as a "fill." It stands beside the camera so as to give no double shadows. A diffusion disc or two serve to cut the intensity below that

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of the key light, so the shadows are not erased but merely softened. Frequently a floodlight in a reflector supplies background lighting. Those are the four basic lights I use, but rarely are they all in action on the same shot. Two or three is the usual thing.

A scene which tells a story will usually encompass more territory than a portrait, and here a photoflood will prove more useful as the chief light source. The spot, however, is still valuable as a backlight. As with the outdoor pictures, plan the setting carefully



SERIOUS WRITING. Child-like activities are always picture-worthy. This young lady was only too anxious to display her prowess with the pencil and paper and soon forgot the camera in her intense concentration. Two No. 2 photofloods in reflectors lighted the scene
Photo, Judith Russell Webster



AT SCHOOL. Pictures of children at school are used more and more by school publicity committees, educational magazines, etc., and this kind of child photography calls for a technic all its own. The shots must be appealing, yet candid—and at the same time they must give the educational value of the activities shown
Photo, Barbara Morgan

and arrange the lights before the child comes in. From then on, it's everyone for himself as the youngster probably won't pay any attention to your desires, and you will have to outguess him. Your chief weapon will be to interest him in a specific game or toy, and shoot while he's absorbed in it.

FLASH LIGHTING

Photography by flash is no longer the property of the news cameraman alone. Inexpensive synchronizers, peanut size flash-bulbs, and the new multi-flash technic have made it equally popular among the amateurs, who have found that a flash in the hand is often worth two hours of posing.

You can begin with a hand-held reflector if you're short on the equipment side. After focusing, just open the shutter, flash the

bulb, and close the shutter. That's the easiest way, and it gets results every time.

The next stage calls for a synchronizer which fires the bulb and operates the shutter at the same time. That's how action flash shots are made.

Stage number three is multi-flash. Most modern synchronizers have plug-in devices for the use of one or more extension flashes, with which you can achieve that same modeling as we got in the portrait set-ups.

With a good assistant to hold a second flash high and to the rear, you can follow the subject around and take advantage of any expression that might "click" in a picture. There's no question of your subject moving away from the lights.

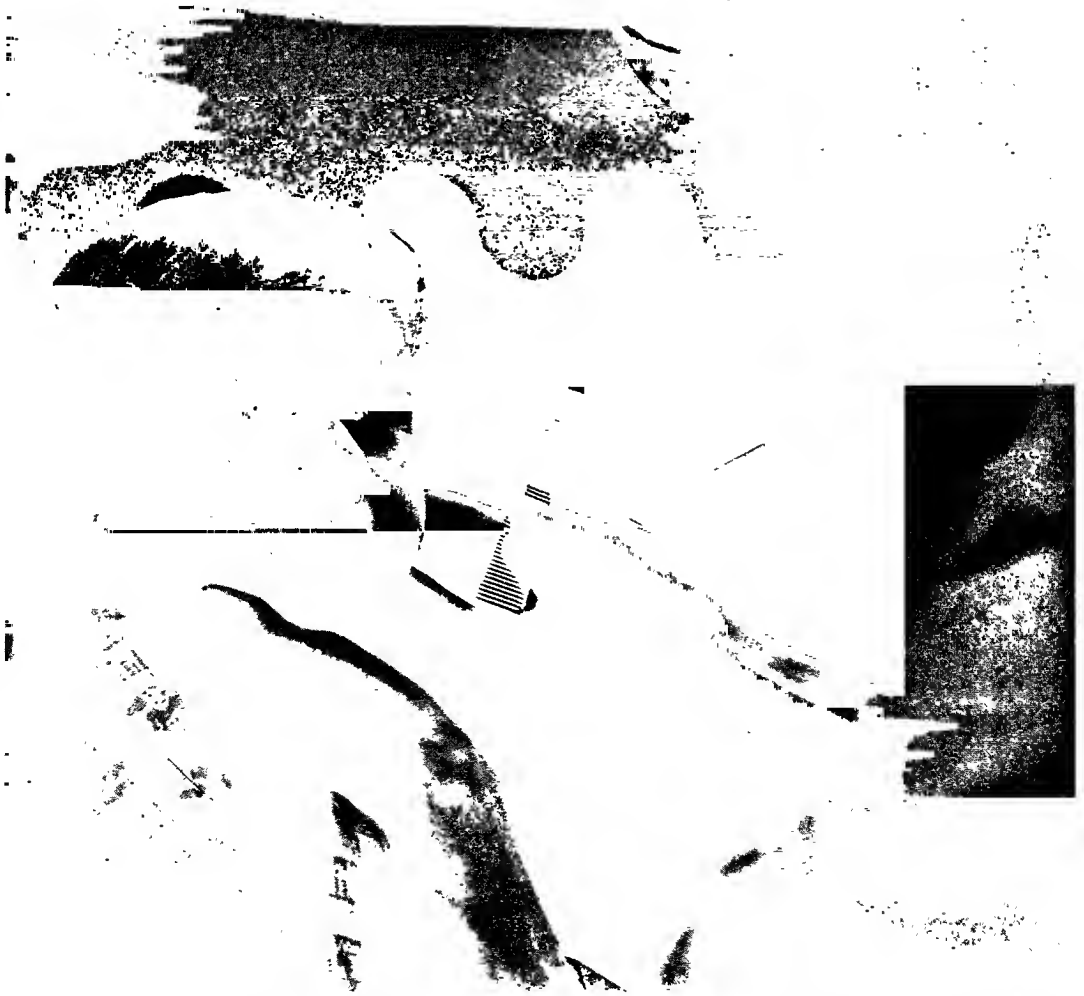
Most photographers who haven't tried it, have an inherent fear of the technical prob-

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lems of flash photography, principally calculating the exposure. Flash photography is not easy, of course. You'll be glad to know, however, that there is a simple rule which solves most of those worries.

Here it is.

When the flashbulb, exposure speed, and film all remain the same, there is a standard "flash factor." It is the product of the lens stop times the distance from the bulb to



FIRST HAIR CUT. The child photograph can often tell a story—and here is an unusual one. Of course photographers have for years been posing smeared children half in the jam pot or cookie jar. But there are always new stories to tell

Photo, Torkel Korling

the subject. For example, if you get a correctly exposed negative when the distance is 10 feet and the lens stop is $f/14$, the flash factor is 140. Remembering that, when you find yourself 7 feet from the subject, you know instantly that the lens must be set at $f/20$. That rule is for the main flash, of course. The backlight is arranged for the effect you want, and doesn't enter into these calculations. (See also tables in article on *Flash and Synchroflash*.)

There's no squinting into the lens when you're shooting with flash . . . the youngster isn't aware of the picture until it's made, so he has no opportunity to freeze a stiff smile. It's a closer approach to gaining that perfect naturalness which is the key to all good pictures of children.

POSING

Now that we have that initial problem of lighting under control, let's look around for a place to work. A plain, dull-surfaced, light colored wall is perfect. Don't be afraid to move the furniture. It's worth-while exercise. How many amateur indoor pictures have been ruined because the fond parents did not move a settee or take down a calendar, with the result that little Jane is framed eternally by Joe's Fish Market, December, 1941!

Before the subject appears on the scene, a simple item of make-up should be cared for. Those catchlights will glisten beautifully, if you'll apply—very sparingly—a bit of olive oil or cold cream to the face. A word too



MIDGET BOXERS. There was no hitting below the belt at this Greater New York Fund sports rally, even if one youngster's trunks were torn. Flash pictures of children often catch a characteristic expression or movement. And they are always good material for the newspaper

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about the costume. Keep it plain! Frilly collars and dresses cast bad shadows on the face and arms.

Don't make the picture-taking an occasion when all the relatives gather to cheer Junior from the sidelines and call him to look six different directions at once. Never more than two or three people should be in the room.

Chat with the child, pique his interest with queries about his friends, toys, school work. But don't let the conversation lag. Youngsters are like sponges in the way they absorb your mood, and if you grow weary or impatient they'll react in an instant. And while the lighting, film, and camera are important, it's the expression that makes or breaks a picture. The search for that "just right" expression is the best kind of challenge to a photographer.

COMPOSITION

The composition in children's pictures is limited only by your imagination.

There are no inflexible rules that you must follow, other than the general considerations of balance and simplicity. I have personally given up any attempts to get perfect placement in the groundglass of my camera before shooting. Youngsters move so rapidly that it's often a job to keep them within range of the lens, so I prefer to make certain that they're near the center of the frame, and then concentrate on the expression. The rest can be worked out in the darkroom, when there's time enough for cropping and squaring up.

Previously I mentioned the use of angles to give a new perspective to the pictures. They can be very helpful. So can your advance work in arranging the setting for the shot. But don't work too hard for "unusual-



VIGNETTED HEAD. This method of vignetting—of holding back the background during enlarging—is very popular with child photographers, but should not be overworked. The subject should be in high key and the background should be light to start with, if a pleasing blend is to be had

Photo, Judith Russell Webster

ness"—it's not good with children. After all, the expression is the thing, so don't worry too much about working out trick ideas.

IDEA PICTURES

Give thought instead to producing "idea" pictures. Every one has shot children with toys, dogs, or dolls. But few of them attempt to dramatize childhood experiences such as the discovery of a broken doll, the destruction of an intricate block pile, or the satisfaction of a steal from the cookie jar. You can't just set up the scene and ask the child to look happy or sad on cue. It's a matter of helping him play his games, all the while keeping an eye out for the situation and expression that will tell the story and give you a real "idea" picture.

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Don't assume that anything aside from a happy expression is bad. A good sneeze or a pair of sleepy eyes after a long shooting session can be the key to an outstanding shot. If the youngster gets angry at something, don't think first about cajoling him. Get a picture!

PORTRAITS

There used to be a great vogue for formal portraits of youngsters. They were head and shoulders shots made against plain backgrounds, and usually loudly proclaimed the "watch-the-birdie-now" technic. As I mentioned before, you can't pose children and expect natural pictures. So my preference goes to informal portraits, which are made "on the run" so to speak. Get the child in a

good position, arrange the lights, and then talk, joke, tell stories, and have fun. One of the shots may prove to be a formal portrait with a good expression, when you examine the proofs later. If so, that's fine. But don't try for a posed picture, or you'll shortly have an impressive list of failures. The "arranged candid" is the real picture.

The portraits will likely turn out best if the youngster is seated on a footstool or low-back chair, four feet or so away from the wall. Since most rooms are cluttered with electric plugs and heat registers near the floor, you can set the chair atop a coffee table or convenient bench. That raises the subject above the confused background and makes shooting easier. Arrange the lights as has been suggested above.

The current tendency by the way, is to depart from evenly lighted backgrounds, and spotlights can do much to assist. The effect in "Bedtime Portrait" was made by concentrating the beam from a spotlight through a small "snoot" and centering it on the background. A splash of light at an angle, or a glow from a photoflood bulb (placed on the floor and darkening toward the top) will also help achieve variety. But be sure not to "over-glamorize" children's portraits. Affected poses and lighting are out.

EQUIPMENT

As to the camera for this work, it seems to me that the Rolleiflex is the best for youngsters, because it permits you to follow the action and keep a sharp focus—most of the time at least! Any good reflex camera will give the same results. It is important to have an upright image of the child up to the very instant of exposure. Miniature cameras like the Leica, Contax,



BEDTIME PORTRAIT. Three spots were used to light this shot. One to the left of the camera was the key light. The second, far to the right of the camera, was a backlight. And the third, its beam concentrated through a "snoot" or tube, provided the hot spot on the background
Photo, Judith Russell Webster

CINE EQUIPMENT FOR AMATEURS

Kodak 35, or any other good 35mm camera can be recommended. Next to the reflex type of view finder, the direct view finder is desirable, as it allows you to follow the changing expressions on the face of your young subject.

SPECIAL IDEAS

The popular picture magazines have clearly demonstrated the effectiveness of the use of a series of pictures to tell the story of an event, and we can advantageously borrow their ideas for use with the children.

Such celebrations as birthdays, Christmas, Fourth of July, and the other holidays will immediately suggest themselves. Other occasions equally important to parents are a picnic in the park, the first trip to the zoo, a day at grandmother's, or the summer vacation, to list only a few. Cover those festivities with the camera, and you'll have a set of pictures to be proud of.

Plan in advance the shots you'll need to make the story complete, and keep alert for any spur-of-the-moment situations which will add a touch of humor. Lots of close-ups will go well, but include at least one long shot, to make the setting and activity clear. A study of the "Life Goes to a Party" feature in *Life Magazine* will give you ideas.

The prints can be given special pages in the family album, or you can do more with them. I'm partial to the idea of making up a special book, using various-sized enlargements in a striking, modern layout. You can trim the borders from the prints and rubber-cement them to the pages, or print them directly onto full-size pages of sensitized paper. By masking the paper carefully with the easel, you can achieve the same effect as the smart new magazines. The pages are later dry mounted back to back, placed between celluloid covers and plastic-bound.

From the moment that you spot the child, through the picture taking process, until you have your child pictures presented in an attractive form, you will have problems. These will involve lighting arrangement, lens opening, kind of film, angle, position, enlarging and mounting methods, any number of things. But it's safe to say that one of the most important things is the child's expression. And a knowledge and love of children will help you catch that.

CINE EQUIPMENT FOR AMATEURS

Frederick Beach

Superintendent of Motion Pictures, New York Central Railroad, Former Technical Editor, Movie Makers

An analysis of modern motion picture equipment for the amateur is given here by a home movie expert. In addition to charts, there is advice on how to buy equipment — what equipment is essential — how to take care of equipment. Also given is discussion of 8mm versus 16mm and a frank and helpful explanation of costs.

See Also ABC of Home Movies, Amateur Movies, Cine Photography Glossary, Cinematography — Professional, Continuity in Cine Films, Color Movies, Lenses — Still and Cine, Projection Screens, Projectors, Sound Movies, Tinting Cine Films

American ingenuity in design and manufacturing has placed simple and highly perfected cameras in the hands of hundreds of thousands. With no more skill than is required to operate a box Brownie, amateur movie makers are securing thoroughly satisfactory motion pictures for their entertainment and education.

The mechanical equipment needed for movie making is very small in size. Cameras are scarcely larger than many hand-held still cameras, while projectors are perhaps the size of an ordinary electric kitchen mixer. Screens are collapsible and some take less room than a bag full of golf clubs. Other accessories needed to complete a satisfactory outfit can be kept in a small drawer or closet. Of course, in movie making as in many other hobbies, one can go on adding equipment to his heart's content, but even though this may be satisfying to the gadgeteer, it is by no means necessary in order to get good pictures.

In general it may be said that movies can be made almost anywhere and shown wherever electric power is available. Of course, certain light conditions must prevail in order to secure pictures, but with the right kind of film and lens equipment, it is possible to take satisfactory pictures in a room that is well lighted by ordinary visual standards. Out of doors one can shoot on the dullest days provided his equipment is geared to poor light conditions. Naturally one does not choose these extreme conditions for they do not help to produce the pictures one might desire. Still, the equipment

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of the movie maker is wide in its scope and weather conditions are no longer highly important in respect to picture making.

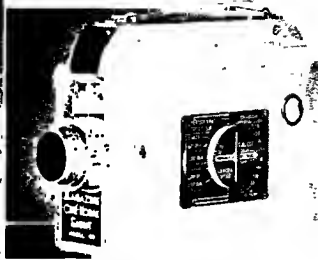
Movies may be shown to relatively large groups of people. While the home group is by far the most popular audience and most equipment is keyed to this need, many of today's projectors can be used efficiently for audiences as large as four or five hundred people. Churches, schools, and other organizations find increasing uses for sub-standard motion pictures. Given a proper screen the ordinary amateur projector can show an image at least six feet in width without reaching the limit of its capabilities. Naturally the more inexpensive types are not quite up to this task but they are wholly adequate for home use and they were manufactured and intended for that use.

The instant availability of the camera, together with its small size, means that it can be a constant companion to the traveler. Priceless records of happenings on trips or during the course of a family's growing-up can easily be made. Contrary to published reports of so called "consumer" testing organizations, the non-inflammable cellulose acetate film used for all 8mm and 16mm motion pictures is a remarkably stable material. In spite of claims made that the film will deteriorate badly in about three years, there is no reason why such films will not last indefinitely—certainly much longer than a human lifetime.

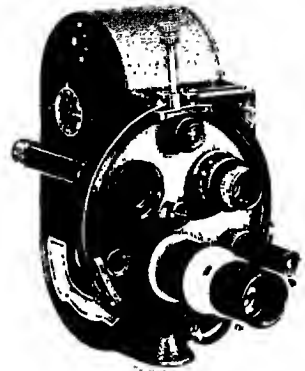
Considering the ability of the movie to re-create the motions and expressions of people, to reproduce in actual color people and scenes which may never be seen again,



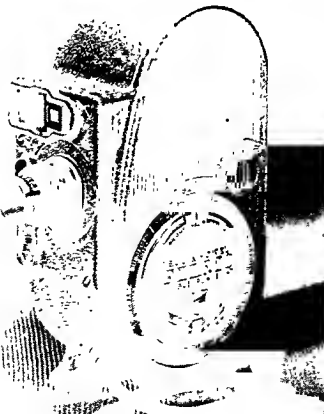
Cine Kodak Eight, Model 20



Magazine Cine Kodak Eight, 90



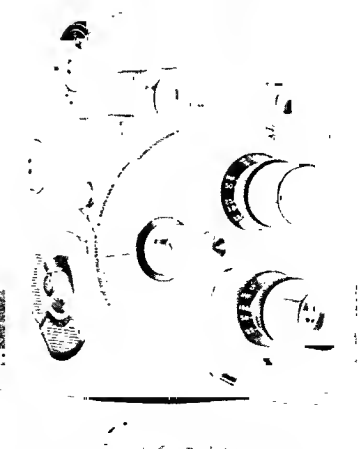
Filmo Aristocrat Turret Eight



Filmo Sportster for 8mm



Revere 88 for 8mm



Revere 99 for 8mm

CINE EQUIPMENT FOR AMATEURS

8mm Camera Chart

Name and model	Film capacity in feet	Type of film holder	Lens mount	Lens	Speeds in frames per second	Single frame	Remarks
Bolex H-8	100	Spool	Thread, 3-lens turret	f/1.5	8, 16, 24, 32, 64	Yes	Backwind, self-threading, motor clutch, visual focuser, parallax correcting finder
Cine Kodak Eight, Model 20	25	Spool	Non-removable	f/3.5	16	No	
Cine Kodak Eight, Model 25	25	Spool	Non-removable	f/3.5	16	No	
Cine Kodak Eight, Model 60	25	Spool	Bayonet	f/1.9	16	No	
Magazine Cine Kodak Eight 90	25	Magazine	Bayonet	f/1.9	16, 24, 32, 64	No	Pulsing footage indicator
Filmo Companion Eight	25	Spool	Bayonet	f/3.5	8, 16, 24, 32	Yes	No sprockets, semi-self threading
Filmo Sportster Eight	25	Spool	Bayonet	f/2.5	16, 32, 48, 64	Yes	No sprockets, semi-self threading
Filmo Aristocrat Turret Eight	25	Spool	Bayonet, 3-lens turret	f/2.5	16, 32, 48, 64	Yes	No sprockets, semi-self threading, critical focus-er optional
Keystone K-8	25 double 30 single	Spool	Thread	f/3.5 f/1.5	12, 16, 48	No	Audible footage indicator
Revere 88	25	Spool	Thread	choice	8, 12, 16, 24, 32	No	
Revere 99	25	Spool	Thread, 3-lens turret	f/2.5	8, 12, 16, 24, 32	No	

16mm Camera Chart

Name and model	Film capacity in feet	Type of film holder	Lens mount	Lens	Speeds in frames per second	Single frame	Remarks
Bolex H-16	100	Spool	Thread, 3-lens turret	f/1.4 or f/1.5	8, 16, 24, 32, 64	Yes	Backwind, self threading, motor clutch, visual focuser, parallax correcting finder
Cine Kodak K	100	Spool	Bayonet, 1 lens	f/1.9	8, 16	No	
Magazine Cine Kodak	50	Magazine	Bayonet, 1 lens	f/1.9	16, 32, 64	No	Variable finder for all lenses
Cine Kodak E	100	Spool	Thread, 1 lens	f/3.5 f/1.9	16, 32, 64	No	Meter visible in finder
Cine Kodak Special	100 or 200 film chamber	Spool	Bayonet, 2-lens turret	f/1.9	8, 16, 24, 32, 64	Yes	Backwind, variable shutter, frame counter, reflex focuser, single frame
Filmo 70-E	100	Spool	Thread, 1 lens	f/2.7*	8, 16, 24, 64	No	
Filmo 70-DA	100	Spool	Thread, 3-lens turret	f/2.7*	8, 12, 16, 24, 32, 48, 64	No	Variable finder, critical focuser
Filmo 70-G	100	Spool	Thread, 1 lens	f/1.5*	128 only	No	For slow-motion work
Filmo Automaster	50	Magazine	Thread, 3-lens turret	f/2.7*	16, 32, 48, 64	Yes	
Filmo Auto Load	50	Magazine	Thread, 1 lens	f/2.7*	8, 16, 24, 32	Yes	
Filmo Auto Load Speedster	50	Magazine	Thread, 1 lens	f/2.7*	16, 32, 48, 64	Yes	

CINE EQUIPMENT FOR AMATEURS

16mm Camera Chart—(Cont'd)

Name and model	Film capacity in feet	Type of film holder	Lens mount	Lens	Speeds in frames per second	Single frame	Remarks
Keystone B-1	100	Spool	Thread, 1 lens	f/3.5	16	No	Audible footage meter
Keystone A-3	100	Spool	Thread, 1 lens	f/3.5*	16, 32, 64	No	Audible footage meter
Keystone A-7	100	Spool	Thread, 1 lens	f/2.7*	10 to 64	No	Audible footage meter
Victor 3	100	Spool	Thread, 1 lens	Choice	8, 16, 24, 32, 72	No	Visual focusing
Victor 4	100	Spool	Thread, 3-lens turret	Choice	8, 16, 24, 32, 64, 80	No	Visual focusing, back-wind
Victor 5	100	Spool	Thread, 3-lens turret	Choice	8, 16, 24, 32, 64, 80	No	Visual focusing, back-wind

*Choice of lenses.

it is a well nigh priceless medium. When one takes movies with a reasonable degree of success, he never gives up the hobby. It is highly important to start out properly and be equipped with an outfit which will do the job well and stay within the budget limitations of the movie maker. Far too often a person is tempted to walk up to the nearest salesman and buy an outfit before he knows what is best for his purpose.

COST OF HOME MOVIES

For most people, cost is an important guiding factor in the selection of nearly all articles which might be called "luxury items." When you buy a camera of any kind, it is necessary to consider not alone the initial cost of the outfit, but the cost of running it. Of course, it is not possible to predict just exactly how much you will spend on film, but it is perfectly feasible to work out in advance just about what you think you *can* spend and determine from this whether you will get enough pictures to make the venture worth while.

Although a smaller figure will accomplish wonders, it is a good plan to figure on spending about \$75 for an outfit. Of course, there is almost no ceiling on this, for it is not uncommon to find amateurs who have spent as much as \$1000 for their outfits. However, if the truth be known, very often these liberal spenders do not take as good pictures as do those who spend \$50 for their equipment. The dollars invested are by no means related to the excellence of the pictures that will result. Perhaps the basic cost for four minutes of movies, when the lowest priced film and equipment is used, runs about \$2. Four minutes is a long time on the screen and many a movie maker uses only one such roll a month. However, this can be little more than a rough guide and something that may help the novice determine just what he will want to spend. It is difficult to make any sort of an estimate regarding the money that one may spend on gadgets and accessories. Many times this is determined by the sales resistance of the movie maker or by the affluence of his friends. If one amateur sees his friend with a new accessory, it is almost sure to mean that he will spend some money.

8MM AND 16MM FILM

Every prospective buyer of an amateur movie outfit is faced with the problem of whether he should buy "eight" or "sixteen." For the benefit of the uninitiated, it would be well to explain these mysterious terms. First of all, they are both included in the category of "sub-standard movies." "Sub-standard" because the amateur film is smaller than the "standard" 35mm film used in the theaters. The motion picture film used in the theaters is known as "35mm film" because the celluloid ribbon carrying the pictures is exactly 35 millimeters in width. For some strange reason, the first film to be generally used, which was smaller than this theatrical size, was only 16 millimeters in width instead of 17.5, as might be assumed. For many years the 16mm grew in popularity until it was widely accepted as the amateur standard. Suddenly a new film width appeared in this country. It was the 8mm film in two. Its chief virtue was economy, for it took a picture which was only one quarter the size of that produced on 16mm. This meant that the cost of the film was reduced, for the roll of 8mm with its 25-foot length and its two rows of pictures, each picture only half as high and half as wide as the 16mm size, could be sold for considerably less than the 100-foot roll of 16mm film. Although the cost was not reduced in proportion to the amount of the film, the new 8mm size saved more than half the

cost. The results which were obtained from this new 8mm size compared very favorably with the 16mm in most respects and although the equipment was smaller it had most of the features people had grown to expect in the larger size.

8MM AND 16MM CAMERAS

The popularity of the 8mm increased by leaps and bounds until it became apparent that the trend was toward 8mm for most of the newcomers to the amateur field. Today some persons who are in close touch with the movie field predict that 8mm will come to be the amateur standard while its larger brother will be used chiefly by those doing commercial and educational movie making. Keeping in step with the growth of the 8mm field, the manufacturers brought out the more advanced equipment, better films, and a wider range of values in cameras and projectors. Today one can pay almost as much for the best 8mm camera as he would for the best 16mm outfits.

In order to aid the prospective buyer of equipment in making his choice between the two sizes, it is necessary to examine a number of facts that may have a bearing on the question. Just how much they will influence his particular choice is hard to explain and he will find that he alone can do it satisfactorily.

Initial investment is probably the point that most people consider first. Here, as already stated, the differential is not great.

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . POMPEII

This picture is a happy combination of the documentary and the interpretative kind of photography.

As to documentary photography, there are three good and fast rules, to wit: be aware of your period; record the facts as well as the symbols; and, finally, be as inclusive as possible. Now this photograph records the detail of the columns as well as the general lay-out of this Temple of Apollo at Pompeii. It has both intimacy and perspective.

The history of the ruins is effectively illustrated by the inclusion of Mount Vesuvius, whose eruption early in the Christian Era was responsible for the destruction of Pompeii. History is the god-father of documentary photography, and if the historical connection can be shown in any convincing way, so much the better for your picture.

In this photograph the composition is such that the eye is surely guided along the columns on the right, along the walls on the left, and across the roof in the background to the cloud that hovers above Vesuvius. Note the repetition of the vertical pattern in depth, represented by the various columns. Note the three horizontal shadows, one in the left foreground, one cast by the stairway (which, incidentally, is beautifully set off in white upon the back wall), and one in the center of the picture.

Gehard Hirschfield







TANYA

WILLIAM MORTENSEN

This interesting nude photograph is an example of the "abrasion control technic," a way of finishing the photograph which gives an etched appearance. Mortensen, a master of figure photography, has chosen the straightforward approach for this nude



RADIOGRAPH OF A ROSE

A. W. FUCHS

For the scientist, photography is becoming increasingly important and scientifically interesting pictures are appearing daily. Some, like this delicate X-ray of a rose, are also beautiful and pictorial in their presentation.

This one is similar to a photogram



BALTIMORE SCENE

HAROLD HARVEY

This is a pictorial composition—but with social content. Not a documentary and not a pictorial. The picture makes this point by contrasting the foreground pattern of the old wagon with the background of the old Baltimore tenement. The two young negro boys give the human touch and establish locale. A good picture, with excellent technic (notice the depth of field and the tones)

CINE EQUIPMENT FOR AMATEURS

(Continued from page preceding insert)

In fact in some cases equipment which may be compared in all respects except film size may be cheaper in 16mm than 8mm. Of course this is not true of the very advanced types of cameras. At the present time the most versatile 16mm camera has no counterpart in the 8mm size. However, practically all other 16mm cameras can be found in the smaller versions.

As far as upkeep or film costs are concerned, the 8mm size has the edge on its larger brother. For example, considering a good quality panchromatic film of medium speed, current prices for a roll of 8mm film would be \$2.16. For a similar running time in 16mm the cost would be \$5.76. This difference is more pronounced in the case of different film types. Kodachrome for the 8mm costs \$3.65 and for the equivalent in 16mm, \$8.55.

Another important point to be considered when weighing one size against the other is the compactness, weight, shape, and their effect on portability. While to some this may be unimportant, to others it may mean a great deal. Not only the smaller size of the camera itself and its lenses, but the tiny film boxes of the eight are factors. The traveler who is likely to be away from his luggage and moving under difficult conditions welcomes the smallest possible outfit. It is also an advantage to use the tiny cameras when the sight of a large one might cause self-consciousness on the part of the subjects.

ADVANTAGES AND DISADVANTAGES

A limitation which will certainly be a small one to the vast majority of movie makers, but which on the other hand might prove a deciding one for a scattered few, is the unsuitability of 8mm for reverse motion. Because of the fact that there are holes on only one side of single eight film, the film cannot be turned end for end. This is necessary after pictures have been taken with the camera upside down. The method is popular with 16mm movie makers in order to secure reverse motion. When the single eight film is turned about in this manner, it is necessary to turn it back for front. This has two effects. One is a mirror image

of the subject, objectionable for titles and some scenes, and the other is that the projected image goes out of focus when the strip comes through the projector. The latter is a result of turning the film about and bringing the emulsion on the opposite side from normal. In doing this the focal plane is changed considerably and bad focus results. This fault can be overcome by immediately refocussing the machine when such a scene comes on the screen and changing it back at the end of the section of film. This is not a very workmanlike way of doing things and is distasteful to movie makers in general.

One of the most noticeable objections to 8mm, in the eyes of a critical photographer, is the definite lack of sharpness in Kodachrome, especially in distance shots. This is due, of course, to the construction of the film where the picture is recorded on three layers of emulsion at one time. By the time the three images, lying in different focal planes, are magnified to the tremendous amount necessary for projection, the result is bound to be a bit fuzzy. In all justice it must be said that this point is not one that bothers most 8mm users. It is generally discovered by those who have switched from 16 to 8 or by 8mm users whose friends use 16mm. A direct comparison does show up the difference. While this point is something to be considered by a critical worker, it is of little consequence to the vast majority of amateurs who are not greatly concerned with a high degree of technical perfection.

The duplication of 8mm Kodachrome has not been satisfactorily done up to date and it would seem that it will be some time before a satisfactory result can be had in this field. Here again is a factor which will not matter much to most amateurs. It might, however, influence someone who had planned to use movies for some phase of his business. Since more and more amateurs are finding uses for motion pictures in industrial and educational fields, this point should be given consideration.

The next point is tied in somewhat to the last one in that it involves the use of film for commercial purposes. At the present time 8mm does not find wide use for business films. Thus if a person expects to dis-

THE COMPLETE PHOTOGRAPHER

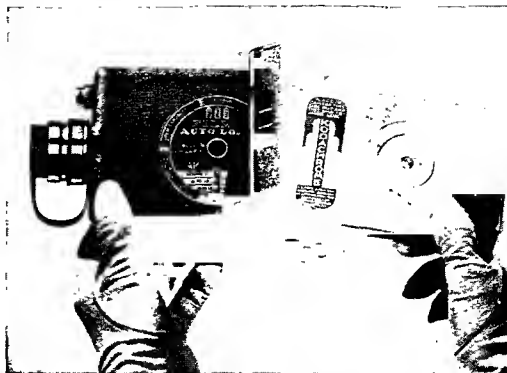
tribute his movie for advertising, publicity, or other types of propaganda purposes, it would be unwise to use 8mm. An exception to this might be found in the case of films made to be shown to two or three persons as a sales promotion idea. A small 8mm projector, screen, and a short film could be used to show several people in an office just what the message was. If the film is sent out without a machine, or if it is designed to be shown to large groups, the 8mm size is almost always ruled out.



Filmo Auto Master for 16mm

denied that these larger screenings are done far better by the larger 16mm film size. It is a technical fact that the 8mm pictures are not as sharp as those taken on 16mm and projected to the same size. This difference, however, is not noticeable enough in black and white to cause the 8mm to be handicapped under normal home projection conditions.

If a study of the foregoing points does not result in a decision in favor of one film width or the other, there is little more that can be



Filmo Auto Load for 16mm

The question of sound for 8mm is at present out of the question, and for technical reasons it does not appear probable that much will be done along that line for some time to come. Present-day emulsions do not have the resolving power needed for a sound track on 8mm film unless the track is moving at a speed equal to 48 frames per second. This would be far too high for economical projection. It is conceivable that some sort of a disc-playing arrangement for synchronizing sound for 8mm may become popular, but up to now the experiments in that direction have not proved very marketable.

The final consideration when comparing the two film widths is the general performance when the audience is considered. Screen size is not important to most amateurs, for they can get an ample screen size from 8mm for their home needs. In some cases, with good projection outfits, they can stretch it a point and get a screen image size large enough for groups at club meetings, church gatherings, and other places not exactly within the province of amateur movies. However, it cannot be

done to aid the procedure. Talking with owners of the two kinds will do little except confuse the prospective buyer. Certainly a systematic checking off of these points should do the trick.

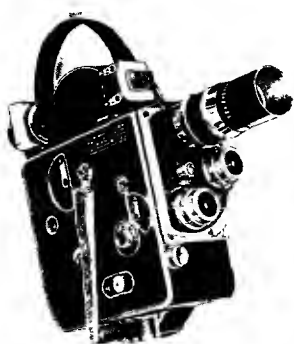
TYPES OF FILM

The question of film and its several types is one that may puzzle the would-be movie maker. Although he may be familiar with the form of still camera film, the long ribbon of pictures for his movie camera may be quite inexplicable to him. Almost without exception, 8mm and 16mm films are of the reversal type, instead of the so-called negative-positive kind. The latter, used by Hollywood and other technicians because many duplicates are needed, is not at all well suited for sub-standard use, and generally brings inferior results. A much more practical system was worked out for amateur movie makers, and it is called "reversal." In this reversal process (see article on *Reversal Process*), the film which is exposed in the camera is processed by the manufacturer, changed from a negative to a

CINE EQUIPMENT FOR AMATEURS

positive, and returned ready for projection. This can be contrasted with the other method in which it is necessary to have the film developed as a negative and then

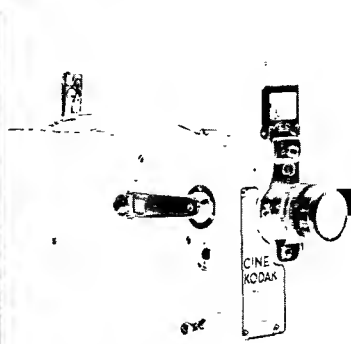
printed on a second film known as a positive. In reversal the two steps are done automatically and a clean, practically grainless picture strip is the result. The processing



Bolex H-16 for 16mm



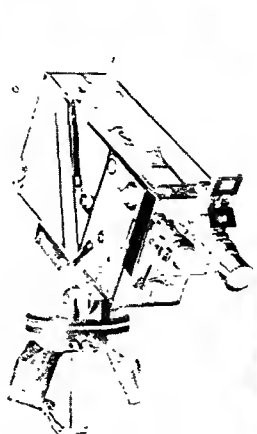
Cine Kodak E for 16mm



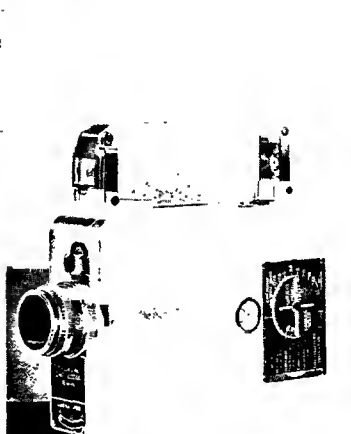
Cine Kodak K for 16mm



Filmo 70-DA for 16mm



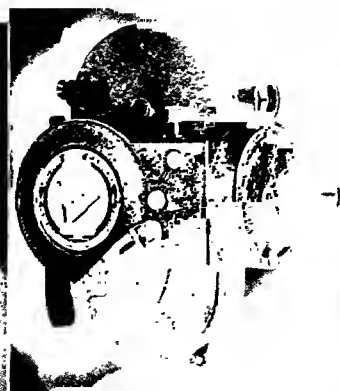
Cine Kodak Special for 16mm



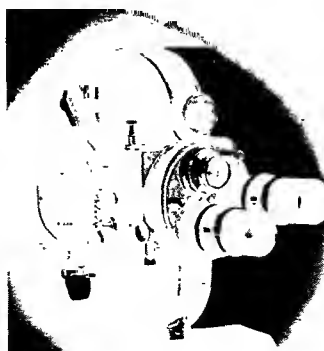
Magazine Cine Kodak for 16mm



Keystone A-3 for 16mm



Victor 3 for 16mm



Victor 4 for 16mm

is paid for at the time the film is purchased, and after exposure the roll is mailed to the manufacturer's nearest processing station.

Besides the two general classifications, black and white and color films, the former is best described according to its speed or sensitivity. As the speed increases, the prices go up. At present, the very high-speed films are to be found only in the 16mm size, but a good fast film for all ordinary work in artificial light may be had in 8mm.

A word of warning against wildcat cheap films is important. Excellent films are made by several large and reputable film companies. Their films cover every need and are processed by the most modern methods. These firms have processing stations all over the United States and in many other important places throughout the world. They are equipped to give first-class service and results. Cheap films are not only poor in themselves, but the companies which sponsor them often do not give world-wide or even nation-wide service. Because their products do not find a wide sale, they are constantly dropping out of business, with the result that customers are forced to pay high prices to have the films developed by other laboratories. While the purchase of these cheap and generally inferior films may save a few pennies in first cost, in the long run they are a poor investment. It is far better to shoot one roll of good film and have some satisfactory pictures than to use several rolls of cheap stuff. In all fairness to one or two companies who have put out a good inexpensive film, it should be said that not all cheap films are of poor quality. In order to tell the worth of a film, check on the reliability of the company handling it and see if they are allowed to advertise in first-class magazines.

Eight millimeter film is commonly sold in 25-foot lengths, which after processing are slit and spliced to make a 50-foot roll of single 8mm film. Sixteen millimeter comes in 50, 100, and 200-foot rolls. While certain obsolete cameras take only 50-foot rolls of 16mm, all current models will take either 50- or 100-foot lengths on spools. Magazine cameras handle only 50-foot loadings in 16mm, and 25-foot loadings in 8mm. Only

the advanced types of cameras can accept the 200-foot rolls, for they are used almost entirely for commercial purposes.

Both 8mm and 16mm films are sold ready to load in daylight. Each roll has a sufficient amount of extra film on the ends to permit ordinary threading and testing in the camera. These ends are cut off after the film has been processed and are not returned to the customer. However, one always gets his full measure of film as the cutting is done by predetermined standards. Careful loading done in the shade will prevent the bad fogging which sometimes takes place when the direct rays of the sun are allowed to fall on the undeveloped film. On black and white film this fog shows up as a white or transparent section, while on color it is apt to appear red. See article on *Fog*.

STORING FILM

It is pertinent at this point to bring in a few facts about the proper method of storing sub-standard film. As has already been pointed out, the United States Bureau of Standards has conducted exhaustive tests on film to determine its keeping qualities. One point which these tests brought out was that the ideal temperature for storage was about 50° Fahrenheit, with 50% as the proper humidity. Of course, most amateurs cannot provide perfect storage conditions as laid down by these specifications, and considerable deviation from them is allowable without the slightest danger to your films. In general, it is simply necessary to avoid artificial heat or dryness. When storing films, do not choose a high shelf in a closet, for the nearer one goes to the ceiling the warmer the atmosphere. Likewise it is dangerous to choose a place that is heated by a steam pipe or chimney in the wall.

Damp cellars should be avoided; but on the other hand if the cellar must be used, the films must be kept away from the furnace, hot water pipes, or other heating units. Probably the best all-around spot in the average home is on the floor of a closet on the second floor. The temperature near the floor of any room is the lowest for that room. If the room is on the second floor or is a sleeping room, it is probably fairly cool most of the time and is certainly cool at

CINE EQUIPMENT FOR AMATEURS

night for a great part of the year. Furthermore, since sleeping room windows are open much of the time, the natural moisture from the outdoor air tends to overcome the drying effects of heated homes.

For many years the conventional storage can for film contained a small blotter pad and was called a "humidor." After some research it was found that more harm was being done to film by too much moisture than by any lack of it. Consequently the leading manufacturer of these cans eliminated the humidor feature and warned users against too much humidification. This was especially true in the case of Kodachrome. Today the best technic for keeping film does not include humidification at any time, unless the film has been subjected to such artificial heat that the moisture has been driven off and the film rendered very brittle. In such cases humidification for about twenty-four hours serves to restore pliability.

In spite of all claims to the contrary, thoroughgoing tests have proved that film shrinkage for 8mm and 16mm is negligible and need not be considered as a danger.

PREPARATION FOR BUYING

When you are thinking of buying equipment, either to replace that which you already have or to start your movie-making hobby, there are a few questions which you must ask yourself. These questions apply with more force to those who are tempted to buy the advanced or expensive outfits than to the person who wants to start off modestly. As in other fields, the shiny chrome-plated cameras and gadgets are tempting and it is easy to oversell oneself on the need for a bigger and better outfit.

First of all, try to visualize just how much the outfit will be used. Decide how much time will be available for movie making, and ask yourself if you are the type who will really become interested and want to do some serious filming. If you find that you are not going to have much time, and that you simply want to keep a modest record of your family or your trips, a simple outfit will serve perfectly.

If, on the other hand, you are going to have quite a bit of time to devote to your

hobby, and are the type to do your filming with great thoroughness, you may need an expensive and more versatile outfit. It may be that you prefer to learn the principles of good picture making from the ground up and will want to start with a simple outfit and proceed until you have mastered such things as exposure, composition, and continuity. In that event, you would do well to buy a simple but good camera and concentrate on learning the important facts about pictures. Later you can secure the more advanced camera and learn to use it to expand your technic.

If you are a stickler for quality and will not hesitate to pay a good price for the finest, do not worry too much if you think the simple camera you have selected does not look quite as well made as your friend's new outfit. Actually, the cameras on the market today, even in the lower price brackets, are thoroughly sound as to wearing quality and most of them would far outlast their owners under ordinary filming conditions. Stop to think a minute about the total running time of a camera as compared with other familiar mechanical devices in your home. Surely it will run far fewer hours in the year than sewing machines, vacuum cleaners, washing machines, electric razors, and many other machines. You can see that a camera would have to be badly made indeed to wear out in ordinary use.

These simple cameras have one excellent virtue. They make the user concentrate on the fundamentals instead of wondering how he can use the various features and gadgets. *Never be scornful of the simple outfit, for it will teach you a great deal.*

If you are one (as many of us are) who is always casting envious eyes on the other fellow's more versatile outfit, and is constantly looking at the new cameras in store windows, then, too, you must consider the future. While not many cameras can be purchased with the idea of adding features later on, one or two of them are so designed. For example, it is possible to have backcranking, single frame release, critical focusing, and other minor facilities added to several makes of cameras. In this respect, it is very important to ascertain the cost of these improvements and additions before

you buy the camera. You may find that in order to secure these desired features for your camera, you would have to pay more than you would if you bought a camera which already incorporated them in its design.

If you are gadget-minded in this way, be sure to have a thorough understanding of just what a camera will do before you buy it, and also just what features may be added and what they cost. Many a movie maker has paid a high price for a camera and a still higher price for alterations only to find that he has a less versatile unit than could be made in a standard model of another make. Many movie makers and, unfortunately, many dealers are not fully acquainted with these facts, and often a study of advertising literature put out by the manufacturers does not clear up all points in question. The best method is to study the camera first-hand at a store and have the clerk explain each feature to you.

A very good example of the point just mentioned is found in the case of one well-known advanced type of camera. This camera is the only sub-standard movie camera which has a reflex focusing feature showing the exact image as it will appear on the film with any lens in taking position. Other cameras have critical focusing features, some of which do not show the full image in the groundglass viewing window, but show it in an offset position or require special sliding bases for the camera. Magazine cameras show exactly what is going to be photographed on the film provided a special focusing device is used in place of a magazine. This point is mentioned simply as an example of the features that have to be seen to be understood in many instances. Descriptive literature does not always make such features clear to the prospective purchaser.

Although sound for the amateur has not yet reached the practical stage from the standpoint of cost, portability of equipment, and ease of operation, some people may feel that they will wish to try sound filming later on. In that event, it is important to buy a camera which will run at 24 frames a second, and, better yet, one which may easily be fitted with a motor drive. Sound at the

present time is almost entirely restricted to commercial productions.

Perhaps you have pre-conceived ideas about what you wish in camera versatility. These are very often the result of seeing other amateurs' films or reading about them in various publications. You may want to make a film which has considerable animation in it. In that event you will need certain features in your camera. First of all, you would need a single-frame release in order to do first-class stop-motion work. If the work is to be done at close range, you will need a focusing lens and possibly some means for accurately centering and focusing the image. If you are in doubt about what features you need, talk the problem over with the owner of an advanced camera and ask him what he thinks about it.

In order to help the movie maker know what is available, charts are presented on pages 733, 734, and 735. The fundamental points about each camera are given, although some of the fine points have been left out. Each manufacturer has certain refinements which he feels enhance his particular product, and no doubt they may mean a lot to some purchasers, but the actual working principles of the cameras as shown are the important ones. Prices have not been given because of the fluctuating price level. Your dealer or the manufacturer will know current prices, though.

CARE OF YOUR MOVIE CAMERA

A movie camera is a precision instrument and as such it must be treated with care. The first step in this care should be the purchase of a good carrying case, if one did not come with the machine (see article on *Cases*). This will preserve the camera not only by keeping it away from dust and moisture, out of the hot sun, and make it less liable to theft, but it will prevent it from getting a good many hard knocks. While cameras are pretty tough, they may be damaged by a hard blow which can spring the cover enough to cause it to leak light. If the case supplied by the manufacturer does not have all the compartments or room that you need, you can easily have one made at a good luggage store. It can be made to fit your exact requirements. Compartments lined with felt

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should be provided for extra lenses, meters, and other accessories. And if you want to spend two or three dollars extra, order a combination lock. That will eliminate the necessity of carrying a key around with you and possibly losing it.

As soon as you get your camera home, settle down with the instruction book and read it carefully from cover to cover. Learn not only how to operate the camera but how to oil it and keep it in first-class condition. Some manufacturers give specific oiling instructions and others caution against using any oil. They know what is best for their camera, so follow their advice. If you are instructed not to oil the camera, do not worry about its needing lubrication, for it is designed to run a long time before requiring attention. An excellent plan is to return your camera to the factory every winter for a check-up, cleaning, and oiling. It is inexpensive and the best kind of insurance against bad pictures due to mechanical failure.

If a brush is not supplied with your camera outfit buy a small one for dusting off lenses and cleaning the gate and aperture. The camel's hair type is best since it is too soft to scratch the lenses. Make a practice of cleaning out the aperture and gate before each day's shooting. If you neglect this point, you may find a whole roll of film ruined by a long straggling hair or a wavering clump of dust photographed at the top or bottom of your pictures. Not only can such things be unsightly, they can really scratch film. A tiny speck of grit can cut a black scratch the entire length of a roll. Some films give off a powdery substance which may collect on the aperture plate and cause the fuzzy edges already referred to.

Lenses and filters need the same kind of dusting with a camel's hair brush, and wiping with a sheet of lens tissue. If finger marks remain after wiping, you can use one of the special lens cleaning fluids or breathe lightly on the glass and immediately wipe off the moisture with tissue. Beware of cleaners that contain alcohol as this may work its way into the lens itself between the elements. In the case of a filter made of gelatin sandwiched between glasses, the same caution applies. Filters of this type, as well as all lenses, should be kept out of the sun

when not in use and away from high temperatures at all times.

For protection against moisture and dampness at the sea shore, or in other places where the humidity is very high, try wrapping the camera in an oilskin bag, such as those sold for keeping meat or vegetables fresh in a refrigerator. A bag used to cover an electric mixing machine is handy to use on the camera when it is on a tripod. The covering will save it from spray or rain in case you are caught away from your case.

If you plan to do much filming at very low temperatures, it is a wise plan to send the camera back to the factory for special lubrication treatment. The lubricants generally used in cameras tend to congeal somewhat in very cold weather, and this results in a slowing down of the mechanism. In lieu of this preparation you can try using one or two small chemical heating pads strapped to the sides of the camera. Two of them joined by tapes and laid over the camera like saddlebags make a good heating unit.

BUYING A PROJECTOR

When considering a projector, you will find that there is a great similarity in the features of nearly all machines. The tables on pages 744 and 745 summarize the current models. Certain features have been omitted from the chart because they are common to all. For example, all machines listed will run on either AC or DC with the exception of the one that is marked. Principal differences lie in the matter of personal opinion. Prices have not been included because of the fluctuating price level.

There are two important aspects of projector care. First is cleaning and second is oiling. Cleaning is important for the same reason that it is in the care of cameras. Accumulated dirt can ruin film in the projector and is much more likely to do so than in the camera because the films are run through the projector many times. Accumulated dirt can do irreparable damage to priceless pictures. A brush for cleaning the film channel parts is a necessity and these parts should be gone over each time the machine is used. Film picks up a good deal of dirt simply running through a projector and also while being rewound. The static

8mm Projector Chart

Name and model	Film capacity in feet	Lens	Lamp power in watts	Still picture	Pilot light	Reverse	Remarks
Ampro	200 400	f/1.6	500	Yes	Yes	Yes	
Bolex G816, 8 or 16mm	400	f/1.6	750 or less	Yes	No	Yes	Voltage control
Bolex G3	400	f/1.6	750 or less	Yes	No	Yes	Voltage control
Filmo Master Eight	200	f/1.6	500	Yes	Yes	No	All geared, no belts
Filmo Master Eight 400	400	f/1.6	500	Yes	Yes	No	All geared, no belts
Keystone M-8	200		300	No	No	No	
Keystone R-8	400	f/1.8	500	No	No	No	
Keystone A-8	400	f/1.6	750	Yes	Yes	Yes	
Kodascope Eight-33	200	f/2	500 or less	No	No	No	Replaces Eight-50, Eight-25, and Eight-20
Kodascope Eight, Model 70	200	f/1.6	500 or less	No	No	No	
Kodascope Eight, Model 70-A	400	f/1.6	500 or less	No	No	No	
Revere 80	300	f/1.6	500 or less	Yes	No	No	All geared, no belts
Revere 85	300	f/1.6	500 or less	Yes	Yes	No	All geared, no belts

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16mm Projector Chart

Name and model	Film capacity in feet	Lens	Lamp power in watts		Pilot light	Reverse	Remarks
			Still picture	Movie			
Ampro KD	400	f/1.6	750 or less	Yes	Yes	Yes	
Ampro US	400	f/1.6	750 or less	Yes	Yes	Yes	May be converted to sound
Ampro YC	1600	f/1.6	1000 or less	Yes	Yes	Yes	May be converted to sound
Bolex G16	400	f/1.6	750 or less	Yes	No	Yes	Voltage control
Bolex G816 (for 8 or 16mm)	400	f/1.6	750 or less	Yes	No	Yes	Voltage control
Bolex G3 (for 8, 16, or 9½mm)	400	f/1.6	750 or less	Yes	No	Yes	Voltage control
Kodascope FF, Series II	400	f/1.6	750 or less	No	No	No	
Kodascope G	400	f/1.6	750 or less	Yes	Yes	Yes	
Filmo Master	400	f/1.6	750 or less	Yes	Yes	Yes	Gear driven, no belts
Filmo Diplomat	400	f/1.6	750 or less	Yes	Yes	Yes	Gear driven, no belts voltage control
Filmo Showmaster	1600	f/1.6	750 or less	Yes	Yes	Yes	Voltage control
Filmo Auditorium	1600	f/1.6	1200	Yes	Yes	No	Motor take-up, film conditioner
Keystone A-72	400	f/2.5	500	No	No	No	
Keystone A-75	400	f/2.5	500	Yes	No	No	
Keystone A-81	400	f/2.5	750	Yes	Yes	Yes	
Keystone A-82	400	f/1.6	750	Yes	Yes	Yes	Enclosed arms
Victor Master 16	400 1600	f/1.6	750 or 1000	Yes	Yes	Yes	Automatic film trip

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electricity generated when the film is moving rapidly attracts dust. Just a little bit too much oil in the projector will make itself known by spattering on the film and cause the dirt to adhere to the surface of the gate and aperture plate.

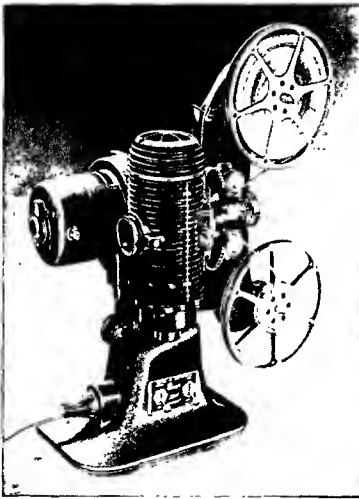
Oiling is important, but it should be done carefully and properly according to the manufacturer's directions. Use the proper kind of oil and apply only enough to fulfill the requirements of the instruction book. Lack of oil will result in a gradual slowing down of the machine and necessitate a trip to the repair shop.

Keep your projector in its case away from dust and safe from damage by rough handling. If you have a permanent projection

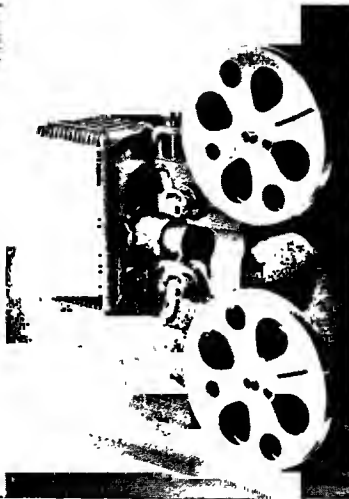
room set-up in your basement, be sure to have a dust-proof cover to put over the machine when it is not in use. Better still, put the machine back in its case or in a cabinet when you have finished with it.

TYPES OF SCREENS

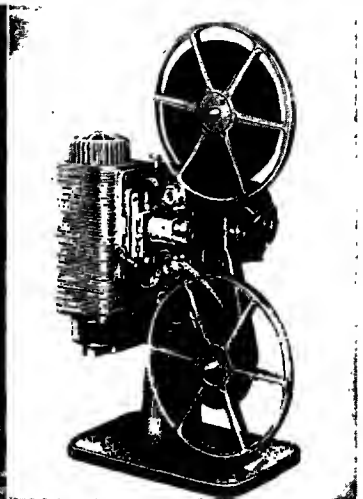
While the camera and projector are the principal tools of the movie maker, there are other items which are equally important. Some of these are necessary in order to show the pictures after they have been taken and others are simply luxuries or aids which are handy to use. The wise amateur will buy the necessities first and then add the gadgets. As he learns of the need for them and the best types to acquire, gadgets are bought.



Filmo Master for 8mm



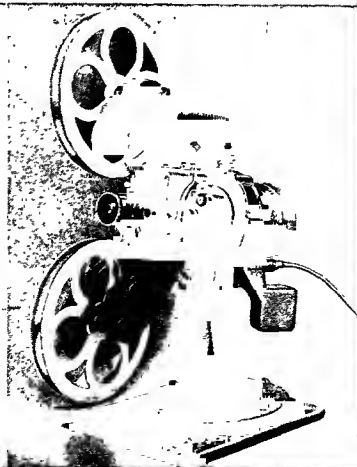
Kodascope Eight-33 for 8mm



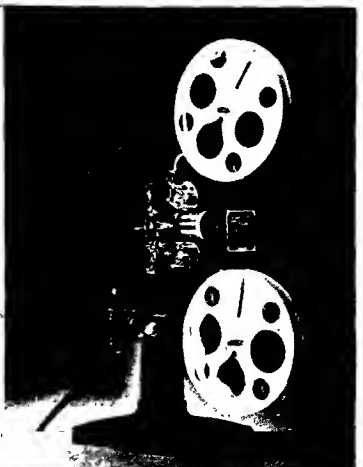
Revere Projector for 8mm



Ampro KD Projector for 16mm



Filmo Master Projector for 16 mm



Kodascope EE, Series II for 16mm

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Probably next in importance to the projector is a screen. While it is possible to show pictures on a white sheet or a light wall, this method is certainly not to be recommended. It is especially bad to show color pictures on a light cream wall for the results will appear much too red and quite likely far too dark. Ordinary white surfaces generally do not reflect enough light. A clean white calcimined wall is about the best homemade type of surface for color or black and white. Some amateurs like pure white blotting paper for color film screens. Neither of these surfaces can approach the reflecting quality of a modern glass-beaded screen, however.

There are three types of screens widely sold today. They are flat white, glass-beaded, and silver-surfaced. Each has definite characteristics which may make it suitable for certain conditions. The glass-beaded is the most popular kind, for it gives the most pleasing result in a large majority of cases. The chief difference in screens lies in the amount of light reflected and the angle of reflection. A good silver screen probably reflects the most light if it is viewed from directly behind the projector. A beaded screen comes next in brilliance and with it the brightness holds up better as one moves to the side of the projector. The flat white type never gives the brilliant image produced by the others, but its image brightness holds up well even when the audience is spread far to the sides of the room. Thus it may be said that the silver screen is suitable for a very narrow room; the beaded for an average room; and the flat white for a wide room. Very often, even though a white screen is used in a wide room, the image does not seem bright enough, but there is no remedy for this except to increase the power of the projector.

Screens vary in form somewhat even though the materials are the same. Simplest is the so-called "map case" type, which is similar to the pull-down maps often used in school rooms. The screen is on a spring shade roller and encased in a metal tube. For use, the screen is pulled down like a window shade and returned to its case after it has been used. This type is suited to a permanent installation. A second kind is the roller shade

placed in a box. Here the shade is supplied with folding supports at either end which lower into the box when not in use. They hold the screen upright when the box is placed on a flat surface. This is the most popular type and is easy to store and transport. The tripod style is gaining in popularity for it is complete in itself and no table or other supporting surface is needed. The roller is encased in a metal tube and the tube is fastened to a collapsible stand. The entire unit when opened will stand alone and the height of the screen can be adjusted in some models. This is most convenient.

EDITING EQUIPMENT

Among the partial necessities which will be acquired early in the game is the editing outfit. The basic parts of such a unit are rewinds, splicer, and viewer. Although all projectors have power rewinds, these are not convenient for use in editing. A pair of manually operated gear-driven rewinds is important for rapidly shifting film from one reel to another. Some of them have a clutch feature which allows the crank to disengage while the reels turn; others have a brake to aid in keeping an even tension; and at least one make is designed so that the reel turns in the same direction as the crank. All of these features are fine, but not essential to good work. To some they may be of great value and to others they may mean nothing. Again, as in so many phases of movie making, the amateur must rely on his own tastes for guidance in buying.

The second unit of the editing outfit is the splicer. There are two principles of splicing in vogue today. One involves cutting the film at right angles to its length; the other makes use of a diagonal cut. Proponents of the diagonal splice argue that it is stronger than the straight splice. Practical experience does not indicate that there is a discernible difference. It actually makes no difference which you use, but you may find a properly made straight splice less visible on the screen. The standard splicers nearly all employ a dry scraping device, although one very fine make, which is widely used by professionals and those who need a heavy solid machine, involves moistening the film before scraping. This again is a matter of opinion. One

thing that may be said about splicers for 8mm film is that most of them make too great an overlap. When choosing one, try to find a make which gives a short lap.

Viewers range all the way from a simple magnifying glass to machines which show the picture in motion. The latter type is definitely a luxury and there are many intermediate models which serve the purpose very well. Those which give a magnified, still image of one frame at a time are highly satisfactory and their cost is more in line with what the average movie maker wishes to spend if he is on a budget.

LENSES

Most movie makers acquire one lens with their first camera and soon begin to think of adding others to increase the versatility of their outfit. The wide-angle lens is a good first choice, for it will be found extremely useful. The average movie maker will find this of more value than a telephoto lens. The first telephoto to be acquired should be the 3-inch or its equivalent for an 8mm camera. This focal length gives a moderate telephoto effect and will be found generally useful. Some may find a 2-inch lens or its equivalent handy for certain types of work. Those who expect to do some kind of special work, such as taking pictures of birds or animals, may need the extreme power of the 6-inch lens. Other intermediate focal lengths adapt themselves to the various special fields open to the movie maker.

Extension tubes are used to place between the lens and the camera in order to focus properly on subjects only a few inches from the camera. They are a necessity if one wishes to do microscopic photography with a movie camera. The only set of these on the market is designed to be used with one make of camera. The set consists of several tubes of varying lengths which can be screwed together in different combinations and used with a full assortment of lenses. They can be made to cover a wide range of magnifications. Since the normal speed of the lens is altered when these tubes are used, it is necessary to use a special scale or table in order to calculate the exposures. The manufacturers of the tubes supply a special calculator at a nominal price.

One "must" for all telephoto work is a steady tripod. Although it may be possible under ideal conditions to hold a 2-inch lens steady while taking pictures, very few skilled movie makers can hold a 3-inch without wobbling, and certainly not a 4- or 6-inch. Some makes of telephotos are designed so that they will focus on objects very close to the camera. Under such conditions the focusing scale becomes inoperative, necessitating the use of a reflex or other critical focusing device.

When it comes to choosing a tripod, one will find a large variety available. Not only do the construction details differ somewhat, but also the prices. There are only two real tests for a tripod—rigidity and portability. Very often any tripod may seem rather large to be carried around with all the other equipment needed, but certainly no better investment can be made. For those who feel the need of a camera support but who will not be bothered with a full fledged tripod, there are single-legged supports known as unipods. These are better than nothing at all, but they cannot take the place of the conventional tripod with the swivel or pan heads. In addition to the tripods themselves, it is possible to buy small dollies or tripod trucks so that the camera can be easily rolled from one point to another between shots or during filming, using the moving camera technic.

FILTERS

The problem of getting filters to fit all the lenses you may have is likely to be a somewhat complicated one. The best way to go about it is to buy from the lens manufacturer filters made for your particular lens. No truly universal filter mount has yet been devised. Ordinary practice is to use slip-on cells which fit snugly on the lenses. Sometimes certain combinations of filter holders and sun shades can be worked out for two or three lenses, but ordinarily the only answer is to buy a filter for each lens. Two filter materials are available: solid colored glass and tinted gelatin between optical glass discs. The solid glass kind are the most durable and often the most inexpensive. The gelatin-between-glass types are available in

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a wider variety of colors, but that is of little consequence to the amateur. Only three or four filters are needed for any outfit.

SPECIAL EQUIPMENT

The use of the fade and dissolve has become more popular in recent years with the introduction of cameras with backwind features. Various special clockwork gadgets have been invented for the purpose of making fades. These operate by using a disc or blade which revolves before the lens, or a series of blades which close, cutting off the picture. Some of them are operated by hand and others by a spring-driven motor whose speed may be varied. All such devices must be placed on the front of the camera before the lens. The ideal fading arrangement is a variable shutter in the camera. This type can be closed while the mechanism is running and gives a smooth and effective fade-out.

In the field of focusing and centering, there are several special gadgets which are of tremendous help in certain instances. Owners of magazine-loading cameras can get focusing devices which slip into the camera in place of the magazine. They show the exact field of the lens on a groundglass and provide a means for accurately centering and focusing the picture. Other focusing gadgets are placed between the lens and the camera and must be used with telephoto lenses or as a type of extension tube with normal lenses. They provide a means whereby the image can be seen on a groundglass in somewhat the same manner as with the previously described devices. Some such aids as this are necessary when making extreme close-ups, for the depth of field is so shallow that the slightest movement of the subject throws it out of focus. Furthermore, the conventional finders are not efficient at very close range and unless the groundglass focusing method is used, one cannot tell when the subject is properly in the picture.

In concluding, it is important to point out that no survey can adequately describe the applications of the many outfits. Consultation with your dealer is one of the best ways of learning and if he does not stock the particular item you have in mind, write to the manufacturer for catalogs and other literature. Of course, when all is said and

done you will probably want to see the item before buying it, and that will enable you to learn just what it does.

Remember that equipment seldom makes the picture. It is the man behind the equipment who does the real job. Good equipment can only supplement his efforts.

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Frederick Beach

Superintendent of Motion Pictures, New York Central Railroad; Former Technical Editor, Movie Makers

**A definition of terms is always a good idea—
and here is a compilation of cine photography
terms for the amateur movie maker.**

See Also Dictionary of Photographic Terms

Angles, Camera—Various positions of the camera in relation to the subject.

Animated Titles—Titles which contain movement of letters or background or both.

Animation—Imparting movement to inanimate objects or drawings by photographing their movement frame by frame.

Animation Table—A stand designed to hold drawings in a fixed position while they are photographed to make animated cartoons.

Anti-halation Backing—A coating placed on the film base to absorb stray light rays from bright parts of a scene.

Aperture—Opening in the film channel which limits the size of the image formed on the film by the lens.

Art Title Background—A specially drawn or photographed background on which a title is lettered.

Backlighting—Light which falls on the subject from the side opposite from the camera.

Backwind—A feature which permits a camera mechanism to be turned in reverse.

Base—Transparent acetate ribbon on which the emulsion is coated to make motion picture film.

Chemical Fade—A fade-out or fade-in made by dyeing film to a progressively greater or less density, using a black dye.

Cinching—Abrading coils of film on a reel by pulling the loose end while the reel is held stationary.

Cinematography—Motion picture taking. Derived from the British "cinema."

- Claw*—Hooked member of pull-down mechanism which engages film perforation.
- Close-up*—Picture made with camera close to the subject. Often means head and shoulders view of a person.
- Color Blind Film*—Film not sensitive to colors other than blue.
- Continuity*—The plan and order of shots in a motion picture.
- Contrast*—Range between darkest and lightest parts of a picture or scene.
- Critical Focuser*—Means for viewing the lens image on a groundglass in a motion picture camera.
- Cue Sheet*—List of directions telling when music and sound effects should be brought in during the showing or recording of a motion picture.
- Cut*—To change subject while filming. To edit and arrange scenes after processing has been completed.
- Depth of Field*—Range ahead of and behind point focused upon in which focus will be satisfactorily sharp.
- Diaphragm*—A set of thin metal leaves forming the lens opening, the size of which may be altered at will in order to control the amount of light passing through a lens.
- Diffusion*—Process of making a picture appear soft and indistinct by using a screen to break up the rays of light before they enter the camera lens.
- Director*—Person in charge of actors, cameramen, and other technicians during the making of a motion picture.
- Dissolve (also called lap dissolve)*—An effect in which one scene on the screen appears to merge with and be replaced by a second scene.
- Distance Meter (also called range finder)*—An optical device for indicating distance from meter to subject.
- Distortion*—Altering of the normal picture perspective by tilting the camera or placing a special lens in front of the normal camera lens.
- Documentary Film*—A film which purports to be a record picture.
- Dolly*—A special truck for moving a camera during shooting.
- Double Eight*—Film 16mm in width for use in an 8mm camera. After processing, the film is slit in half and projected as 8mm.
- Double System Sound*—The use of a camera for taking the picture and a separate recorder for making the sound track on another film.
- Dual Turntables*—Two electric phonograph turntables with pick-ups in a case used in conjunction with an amplifier and loudspeaker to play sound effects records with silent movies.
- Duplicates*—Copies of sub-standard films.
- Edge Fog*—A light, flashing streak caused by daylight reaching the film during camera loading or unloading.
- Editing*—Cutting apart, rearranging, and splicing together movie scenes to secure proper order and scene length.
- Editor*—A device for viewing the film during editing.
- Emulsion*—Mixture of light-sensitive silver salts and gelatin coated on a transparent base to make film.
- Exposure*—Light from the subject coming through the lens and falling on the film.
- Exposure Guide*—A chart indicating proper lens settings for various subjects and light conditions.
- Exposure Meter*—A device for measuring the amount of illumination present and indicating the proper lens setting.
- Extension Tube*—A tube placed between the lens and camera to enable objects very close to the camera to be sharply focused.
- Fade*—Gradual darkening of a scene until it appears black.
- Fading Glass*—A strip of glass which is graduated from transparency at one end to opacity at the other. It is passed before the lens to produce a fade.
- Film Chamber*—A removable section of a camera containing the film and film moving mechanism.
- Filter*—Transparent, colored screen placed before the lens to eliminate or subdue certain colors.
- Filter Factor*—Amount the exposure must be increased when using a filter.
- Finder*—Combination of eyepiece and frame on a camera, used to show what area is being included by the camera lens.
- Fixed Focus Lens*—Lens which cannot be focused but which gives satisfactory sharpness on all subjects more than a few feet from the camera.

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Flat Lighting—Illumination which comes from directly behind the camera position.

Focal Length—Distance from lens to film when lens is focused on infinity.

Focusing Lens—Lens which can be set to give sharp pictures at varying distances from the camera.

Footage Meter—Dial or other device indicating the amount of film run through the camera.

Frame—A single picture on a motion picture film.

Frame Counter—Dial counter indicating the number of frames passing through the camera.

Hard Lighting—Illumination which causes sharp and deep shadows to appear on the subject.

Hi-Lo Switch—Switching device which permits lighting units to be used in parallel for full brilliance or in series for half brilliance in order to save lamps.

Humidor—Film storage can with blotter pad for adding moisture to dry film.

Hyperfocal Distance—Point nearest camera at which object will be satisfactorily sharp when lens is focused on infinity.

Indirect Lighting—Illumination which reaches the subject only after being reflected from a light surface.

Industrial Films—Generic term applied to business films made for sales promotion, publicity, advertising, and other propaganda purposes.

Infinity—Generally any distance greater than 100 feet from the camera.

Intercutting—Interposing shots of a given action in a sequence on some other subject.

Intermittent Movement—Mechanism in camera or projector which causes film to move past the aperture one frame at a time instead of a in a continuous flow.

Kodachrome—Multi-layer color film made by Eastman Kodak Company.

Kodacolor—Obsolete lenticulated color movie film formerly made by Eastman.

Latent Image—Undiscernible effect of exposure on an undeveloped film.

Latitude—Ability of film to produce satisfactory pictures when exposure varies from normal.

Leader—Unusable film supplied at the beginning and end of a roll of movie film to

facilitate threading and to protect usable film from damage by light.

Lens Aberration—Imperfections in a lens resulting in poor definition on film.

Lens Cap—Cover which is slipped over lens to protect it from dust when not in use.

Lens Elements—Separate pieces of glass used to form a lens.

Lens Flare—Haziness or light streaks on film caused by rays of light striking the lens and being reflected internally by the elements.

Lens Hood—Shade or cover attached to a lens to prevent direct rays of light from striking its front surface.

Long Focus Lens—Lens of long focal length used to secure a telephoto effect.

Long Shot—Distant or full view of subject.

Loop—Slack portion of film between sprockets and aperture which absorbs the shock of the intermittent motion imparted to the film by the pull-down claw.

Magazine Camera—Camera which accepts film already loaded in a special container to eliminate threading.

Mask—Thin cut-out sheet placed before the film or before the lens to limit the size or shape of the picture.

Mask Box—Box or hood which is placed before the lens to hold masks.

Medium Shot—A picture taken at a middle distance, often used between a close-up and long-shot.

Microcinematography—Motion picture taking through a microscope.

Montage—Series of short shots designed to give an impression (i.e. of speed or passing of time) rather than show details.

Multiple Exposure—More than two exposures on the same film.

Narrative—Descriptive monolog used in a sound film.

Negative Film—Film which is developed as a negative and then printed on positive stock, as opposed to reversal film.

Neutral Density Filter—A filter which cuts down the light passing through the lens but does not affect the colors of the subject in any way.

Objective—A lens.

Orthochromatic Film—A film which is sensitive only to blue and green.

Pam—Corruption of "Pan."

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- Pan*—Adj.: Short for panchromatic.
Verb: To move camera while it is running so as to include a greater view.
- Pan and Tilt Head*—A jointed head for a tripod which allows camera to be tilted and swung about on its axis.
- Panchromatic Films*—Black and white film which is sensitive to all visible colors.
- Parallax*—Amount of offset between lens axis and finder line of sight.
- Parallel Action*—Two kinds of action going on at the same time and shown in a movie by using alternate shots of each.
- Perforations*—Holes punched in the side of movie films so that the mechanism can move it through camera and projector.
- Persistence of Vision*—Retention of image by the eyes after the image has actually vanished.
- Photoelectric Cell*—Metal plate which generates a minute quantity of electricity when light falls upon it. Used widely in exposure meters.
- Photoflood Lamps*—Trade name for special bulbs manufactured for photographic use by General Electric and Westinghouse.
- Photoplay*—Motion picture with a theatrical story as its plot.
- Pick-up*—Electrical part of a phonograph holding the needle and transforming its mechanical motion into electrical impulses.
- Portrait Attachment*—Supplementary lens placed over the regular lens to change its focus and make possible the taking of close-ups.
- Positive Film*—A slow, color blind film used for making prints from negatives and for title work.
- Post Recording*—Recording sound for a motion picture after the editing has been completed.
- Pressure Plate*—Movable, channeled plate which by means of light spring tension holds the film against the aperture.
- Processing*—Term usually applied to the developing and finishing of reversal film.
- Pull-down Mechanism*—Intermittent movement.
- Raw Film*—Unexposed, undeveloped film.
- Reflector*—Flat, light surface used to reflect light into shadow parts of a scene.
- Reflex Focusing*—Focusing visually an image which is reflected from behind the lens onto a groundglass screen.
- Reversal Film*—Film which is developed first as a negative and then, by controlled overexposure, reversed into a positive.
- Reverse Motion*—Action which appears backwards on the screen, obtained by filming with the camera upside down.
- Reverse Take-up*—Device which rewinds the film onto the supply spool when the camera is cranked backwards.
- Rewind*—Crank-driven, geared spindles mounted on brackets and used to wind film from one reel to another. Automatic device for doing same on a projector.
- Rim Lighting*—Illumination which accentuates the outline of the subject.
- Scenario*—Written detailed plan for a film, also called a script.
- Score*—Listing and arrangement of music to accompany a film or to be recorded.
- Script*—A scenario.
- Sequence*—Short series of related shots on one subject.
- Set*—Scenery, furniture, and properties used for a movie scene.
- Shooting Script*—A scenario broken down into a list of shots grouped according to locations.
- Shutter*—Mechanical device for interrupting light reaching the film through the lens.
- Single Eight*—Film 8mm in width for use in cameras. Does not require slitting after development.
- Single Frame Work*—Exposures of a subject made one frame at a time.
- Single System Sound*—Recording of sound and picture on one film in a single camera.
- Slow Motion*—Action filmed with the camera running at high speed and projected at a normal rate.
- Sound Track*—Line of varying area or density photographed on the edge of the film and carrying the sound accompanying the picture.
- Splice*—Joint where two sections of film are fastened together by overlapping and cementing.
- Split Screen*—An effect obtained by using masks to block off portions of the picture for double exposure work.

CINEMATOGRAPHY—PROFESSIONAL

Spotlight—A lighting unit giving a concentrated beam of light.

Sprocket—Toothed wheel which engages the perforations in film and moves it through a camera or projector.

Still Picture Attachment—Device for stopping a projector and showing a single frame on the screen. It interposes a heat screen to shield the film from the full heat of the lamp.

Stop Numbers (also called stops)—Markings on lenses designating the size of the diaphragm opening and the amount of light it will pass.

Straight Eight—Same as single eight.

Supplementary Lens — Lens designed to change the focus of a normal lens. See *Portrait Attachment*.

Swish Pan—Rapid swinging of a camera, either starting or ending on a scene of interest.

Take-up—Mechanism which winds film on a reel after it has passed the aperture of a camera or projector.

Technicolor—A color process which is widely used for theatrical films.

Telephoto Lens—A long focus lens which serves a camera like a telescope.

Time Condensation—Single frames taken at intervals and projected at normal rate to speed action and shorten the time for a given operation. Sometimes called time-lapse.

Trailer—A short film advertising future attractions and used in theaters.

Transition—A short series of shots or a special effect used to connect dissimilar sequences or scenes.

Treatment—General plan on which a scenario or script may be based.

Tracking—Moving the camera on a dolly while shooting the scene.

Turret Head—Revolving plate on the front of a camera made to hold two or more lenses and to allow them to be swung into place quickly.

Ultra Close-up—Pictures taken with the camera extremely close to the subject, usually done with the aid of extension tubes.

Unipod—A canelike device fitted with a tripod socket on top and used to support the camera in lieu of a tripod.

Variable Area Track—A sound track whose modulations are caused by a variation in the thickness of a line.

Variable Density Track—A sound track whose modulations are caused by variation in the density of a line.

Variable Resistance—A rheostat controlling the projection lamp voltage which may be varied at will.

Variable Diaphragm—A diaphragm opening which may be changed while the camera is running in order to make fades.

Viewer—A device which magnifies film for inspection during editing.

Wide-angle Lens — A lens which encompasses a wide area of subject as compared with the coverage of a normal lens. Between 70° and 90°.

Wipe-off—An effect whereby one scene is displaced by another with dividing lines between the two.

CINEMATOGRAPHY— PROFESSIONAL

John Arnold, A. S. C.

Head of Camera Department, Metro-Goldwyn-Mayer, Hollywood; Former President, American Society of Cinematographers

Amateur movie makers will be interested in finding out some of the tricks of the trade from one of Hollywood's best cinematographers. We are told about early movie making, the duties of the head cameraman, technic for indoor and outdoor shots. Also given is information on focus and exposure, the use of filters and diffusion, the moving camera technic—and, of course, on color cinematography.

See Also Amateur Movies, Color Movies, Composition in Motion Picture Photography, Lighting Movie Interiors, Processing Cine Film

A PROFESSIONAL motion picture production today may involve an investment as high as two, three, or even four million dollars, and the efforts of many hundred creative workers, technicians, and laborers. Yet the sole tangible result of all this outlay of cash and effort is a series of tiny still pictures, each slightly over half an inch high by three-quarters of an inch wide (0.631 x 0.868 inches), spaced one tenth of an inch apart on a celluloid ribbon an inch and a quarter (1.378 inches or 35mm) wide. There are 16 of these tiny snapshots to each foot of film,

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a total of more than 130,000 of them in the average feature photoplay.

If these tiny pictures fail—if they do not capture perfectly both the physical appearance and the dramatic mood of the scenes and action laid before the camera—that whole vast outlay of capital and labor fails, for it is only through those tiny images that the production can be brought from the studio stages to the world-wide buying public on the theater screen.

WHY MOVIES MOVE

How these tiny snapshots produce the effect of motion is a story that has often been told, but one which is essential before any discussion of professional cinematography.

Of course the effect of motion is an illusion. It is based upon a defect common to all human eyes—an infinitesimal split-second lag in the optico-nervous reactions. Without it, there could be no movies! If you look steadily at a bright light, and suddenly drop an opaque shutter over it, the actual light is cut off, but for an appreciable interval your eye and brain retain an image of that light. If you are looking at a picture, and the picture is suddenly cut off, the same thing happens. Then if, a split second later, a second picture appears in the same place—a picture almost identical to the first one, but with some detail (as the position of a hand or arm) slightly different from the corresponding detail in the first, your mental image-retention will blend the two together, and you will feel that the picture itself has moved. This carry-over of visual impressions is scientifically known as *persistence of vision*.

This has been known, in principle, for more than 3,000 years. There is today in Egypt a temple whose builder, nearly 30 centuries ago, knew and used that principle. Along one face of the temple is a line of huge pillars. Between the pillars are huge murals, each representing the God Ammon, each with its hand raised a trifle higher than the one before. Tradition has it that the Pharaoh used to drive rapidly past this colonnade in his chariot, and, looking at the murals of his God between the huge stone columns, he was flattered by seeing his God apparently lift his hand in salute! From that day to this, men have known how to produce living pic-

tures; only the lack of suitable means and materials held back the birth of the movie until our own time. But, in the nineteenth century, came four developments that made the moving picture inevitable.

INVENTION OF MOTION PICTURES

First was the invention, in 1833, of the "Zoetrope" or Wheel of Life. This consisted of a drum revolving around a vertical axis, and bearing a number of equally-spaced vertical slots in its edge. Between the slots were placed simple drawings of some moving object—a man, a horse, or the like. And like the ancient Egyptian murals, each drawing showed a slightly different phase of that object's motion. Thus when you looked at the revolving drum, for a brief instant your eye, the slit, and the drawing opposite would be aligned. Then the movement of the slit would obscure your view, only to have it restored a split-second later, when you got a glimpse of the next drawing. Persistence of vision blended the successive drawings into each other, and gave the illusion that the drawing was in actual motion.

Then in 1839 Daguerre announced his Daguerreotype process of making pictures photographically—by the action of light bent through lenses upon light-sensitive silver salts. As photography grew from this start, many photographic experimenters theorized upon the possibility of combining the principles of the Zoetrope and photography to produce living pictures.

But it was not until nearly 40 years later that photo-chemistry advanced far enough to make possible snapshot exposures. Then in 1878 Eadweard Muybridge announced the results of his experiments in analyzing motion photographically. He set up 24 wet plate still cameras in a row along a race track, with threads arranged across the track so that as a horse galloped by he successively broke each thread and snapped 24 successive pictures of himself. Combining positives printed from these exposures with a projecting version of the Zoetrope, Muybridge succeeded in re-creating photographed movement. But he was held back from further progress by the physical limitations of the fragile, bulky glass plates which were the only photosensitive material then available.

CINEMATOGRAPHY—PROFESSIONAL

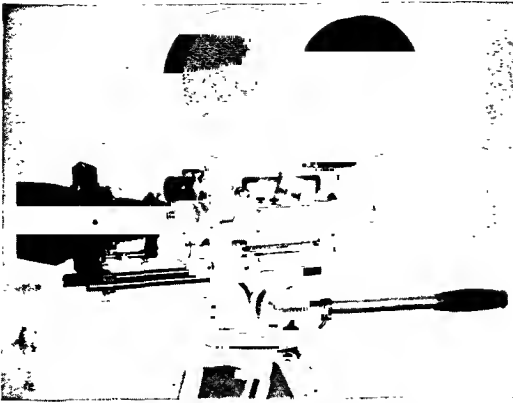
Then in 1888 George Eastman and the Rev. Hannibal Goodwin, working independently, each invented the idea of coating a light-sensitive emulsion on a base of thin, flexible, transparent celluloid. From that

day, the invention of the motion picture was inevitable.

The motion picture, in essentially the same technical form we know it today, was born in 1895. It appears to have had an un-



MOVIE MAKING SILHOUETTE. The director (Ernst Lubitsch), the cameraman, and the huge camera on a rolling rotambulator make a symbolic silhouette against the bright lights of the set. The author invented the rotambulator and also holds basic patents on the soundproof "blimps"



MITCHELL CAMERA. This is a typical 35mm professional movie camera, showing the lens turret and complex lens shade

usual number of parents, for many of the best brains of the time were working on the subject. In this country, Thomas A. Edison is generally recognized as the inventor of the moving picture. In France, the brothers Lumière are especially honored, while in England Friese-Green (who used a paper film for his first experiments) is considered the pioneer. All of them inevitably had to work on fundamentally similar principles: by one of the strange coincidences which are so hard to explain, Edison and Lumière both settled upon film and film-using equipment of substantially identical dimensions—*based on a strip of film 35mm wide*—and established the world-wide standard which has remained virtually unchanged until today.

EARLY MOVIE MAKING

Those principles, as they finally crystallized in practice, necessarily included, in addition to the inevitable light-tight camera box to hold the film and the lens to form the image, a means for moving the ribbon of film past the lens, holding it steadily in place while each exposure is made, and a shutter to cut off the image-forming light while the film is moved from one "frame" or picture-area to the next. A most essential feature—and one which was the basis of the power of the old Motion Picture Patents Co. trust—is providing a bit of slack or "loop" (known as the "Latham Loop") in the film above and below the picture-making aperture, so that the film-travel from and to the film-carrying spools or magazines can be contin-

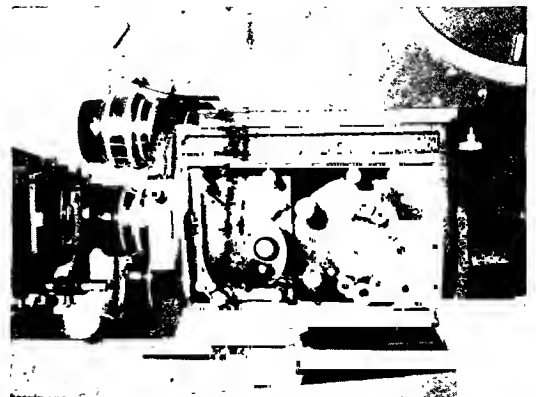
uous without disturbing the necessary intermittent past the aperture as the exposure is made or, in the case of projection, while the image is projected. These basic principles are included in every modern movie camera, from the cheapest of 8mm amateur outfits to the \$15,000 studio cameras that turn out professional productions.

In the early days of movie making, cinematography was unbelievably crude. Even the rawest novice of today would find it laughable. Beginner though he is, he can do better than the best of yesterday's pioneer professionals; cheap though his camera and film may be, they are yet better than the best professionally available then.

The film was incredibly contrasty, color-blind—by no means even orthochromatic. The lenses were slow. Even as recently as 20 years ago lens speeds had not progressed beyond $f/3.5$, and lenses rated at $f/4.5$ or less were common. Many were fixed focus affairs, rigidly set to focus on action 15 feet from the lens—and woe be to the cameraman who placed his actors at any other distance!

The cameras were ramshackle affairs of brass and boxwood, cranked by hand and with none of the refinements of even a modern amateur camera. Few of them could even produce a consistently steady picture. Often two cameras of different makes would not even frame their pictures uniformly with respect to the film's perforations.

The methods of the early cameramen were as crude. Composition was unknown. You



CAMERA INTERIOR. This shows the inside mechanism of a 35mm studio camera. The "Blimp" covering used to deaden the sound of the camera has been replaced, in this Twentieth-Century-Fox camera, by a silencing of the mechanism itself

simply set up your camera and photographed whatever lay before the lens, with no other thought than to get something moving, in focus, and reasonably well illuminated.

Lighting was simply a matter of having enough light—natural or artificial—on the subject so that an exposure was possible. And for many years, lighting meant taking advantage of the sun's free rays (which, it may be remarked, is why the movies came to California where the climate permits year-round movie making outdoors in the well-publicized Southern California sunshine). Even when artificial lighting was introduced, it served for many years only as a substitute for sunlight. It was flat and featureless; practically every old-time cameraman still living can tell true tales of having in those early days incurred official displeasure for daring to suggest experimenting with light effects.

The movies grew up with cinematography. Where at first the mere novelty of pictures that moved had been enough to interest audiences, soon the industry began to tell stories with those pictures. And where in photographing the early films a more or less recognizable image in motion was enough to constitute good photography, cameramen began to strive for natural effects of depth and roundness, to find methods of making the players appear more attractive, and to fit the visual tones of their photography to the emotional tones of the story.

Unfortunately, space does not permit recounting in detail the innumerable technical and artistic advances cinematography has made in the ensuing decades. The studio cinematographer of today has become vastly more than merely a man who understands the technicalities of running a motion picture camera. He has become a specialist in the art of making drama visible. And he does this so perfectly that today nine out of ten of us—in or out of the industry—take good photography almost as a matter of course. We are confident that the pictured effect on the screen will match the emotional values of each scene.

WHAT A STUDIO CINEMATOGRAPHER DOES

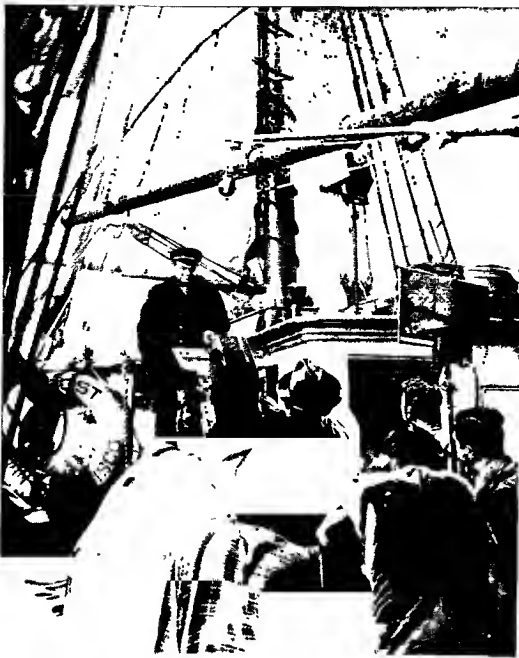
Modern professional cinematography is so intensely specialized, yet covering in the

aggregate such a broad field, that the subject can hardly be treated adequately in the course of a single article. Probably the best way to gain an insight into modern cinematography is to review some of the problems confronting the average cinematographer during the course of a single production.

First of all, he must be familiar with the technical standards of the laboratory that is going to process his film. This is vitally important, for some laboratories develop negative film in solutions which for instance may tend toward high contrast, while in others the developing gives negatives of softer contrasts. If he is familiar with the laboratory in question, all is well; if he has transferred his activities from one studio to another, he will probably make photographic tests to familiarize himself with this factor.

Before starting the production, the cinematographer makes a careful study of the scenario. This tells him not only what physical action he may expect to photograph, but the emotional or dramatic mood of the story. This has a definite bearing on his treatment of his work. If, for instance, the story is a heavy dramatic one, he will plan his photographic treatment with somber, low-key lightings with dark tones and shortened gradational scale which co-ordinate well with the tragic mood of the action. If it is a melodrama, strong, virile contrasts between velvety black shadows and intense highlights will not only help develop a response to the "punchy" action, but show it clearly and swiftly to the eye. If the film is a light comedy, the visual treatment can be essentially normal, tending to light, cheerful tones. If it is broad comedy of the sort purveyed by, say, the Marx brothers, the camera treatment must be simple and fully lit, so that no possible bit of by-play will be lost.

Frequently there may be more than one style of camera treatment possible. Which is best must be determined beforehand, usually through consultation with the director, and often the producer. Some years ago, for example, two celebrated horror pictures—*Frankenstein* (photographed by Arthur Edson, A.S.C.) and *Dr. Jekyll and Mr. Hyde* (photographed by Karl Struss, A.S.C.)—



CLOSE-UP. Unless you look at the upper right-hand corner of this picture, you would think this an outdoor location, when really it was shot on a huge studio sound stage. Notice the general lighting and the position of the two auxiliary lights. Sol Polito, A. S. C., (extreme right) directed the photography for the Warner Brothers picture *Photo, Mac Julian*

were released in comparatively quick succession. Both dealt with similarly unreal, macabre story material, but each was given distinctively different camera treatment. In one, low-key lightings and rather heavy visual diffusion were used to produce an effect of somber unreality. In the other, the treatment was harsh, realistic, by its very realism throwing the incredible monster, Mr. Hyde, into stronger dramatic relief. Both were excellent examples of painstakingly planned and brilliantly executed camera work. Different as they were from each other, each was *right* for the dramatic concept its creators visualized.

Next come the players who are to appear in the films. An incredible number of photographic tests of the principal players will be made before the actual production gets under way. Some of these are of course for the purpose of learning if the players are suited to their parts. Others will be tests of costumes, make-up, hairdress, and so forth. Still others may be to enable the cinematog-

rapher to familiarize himself with the photographic requirements of a star or important featured player with whom he has never previously worked

Then come the questions of sets and costumes. The artists responsible for the creation of these are thoroughly picture-wise, but inevitably there will arise detail questions which call for the aid of a photographic specialist. Is the physical and architectural layout of this set satisfactory for the intended photographic treatment and action? Often a tiny detail overlooked in this pre-production planning can cause expensive delays when the set is being shot. For example, a door hinged to open the wrong way might easily block off the camera's view of a player's face in a scene shot from a dramatically necessary angle, or another door might be too narrow or too low to permit the camera to pass in making an intended dolly or crane shot.

Will this paint or that photograph best? Will this material or that—apparently almost identical visually—give the best results to the camera? Finally, are sets and costumes properly coordinated? Are we likely to find that the art director has provided a white-walled set for Scene 231 while the costumer has designed white or light-colored costumes for use in that scene, while a little later, in Scene 249, the situation is reversed, with dark clothes against dark sets? Either of these, unless forestalled, will require additional time, trouble, and expense in shooting, for lighting will, of course, be more difficult where there is no contrast.

Wherever possible, the cinematographer's aid in further phases of production planning is useful. For example, can this outdoor scene be filmed best by building the set actually outdoors or by building it indoors on a sound stage? Can this night effect sequence be handled in daylight with the proper film and filters, or would it be better to shoot it actually at night, in spite of the extra lighting cost? Here's a location scene planned for shooting at 2 P.M. on the 23rd. Will that particular spot be correctly illuminated at that hour? Can this other action be filmed best by straightforward methods or would it be quicker, cheaper, easier, or safer to make it as a process shot?

CINEMATOGRAPHY—PROFESSIONAL

ON THE SET

Actually at work on the set, the cinematographer's capacity is best described by his title—Director of Photography. He has a three-man crew to take physical charge of the actual operation of the camera. There is always one (and sometimes two) assistant cameraman who tends to such details as the maintenance, loading, and unloading of the camera, measuring focus by tape measure, holding the scene-numbering slate, "following focus" wherever the action makes it necessary, writing up laboratory scene reports, and so on. There is the second or operative cameraman, who actually manipulates the camera, panning, tilting, following, and the like. In addition he serves as a right-hand man to his chief. There is the still man, who shoots the necessary still pictures with an 8 x 10 view camera, a 4 x 5 Speed Graphic, and often a 35mm miniature cam-

era as well. In handling the lighting equipment, the cinematographer's left-hand man is the chief electrician or "gaffer," and his assistant or "best boy," who are in turn in command of an electrical crew.

With these able assistants to take the burden of the detailed, physical work of picture making off his shoulders, the director of photography is able to concentrate on the creative, artistic, and technical phases of his task. He plans the camera angles, camera movements, etc., in close cooperation with the director's dramatic plans. He plans the composition—or more truly, compositions—of each shot. He plans the lighting so that each player is photographed to the best advantage, while the set or room is also lighted to coordinate with the personal lighting scheme. He has to produce the most completely natural, yet pictorial result. In a word, he has full responsibility for conveying



GLAMOUR. Lee Garmes, A. S. C. (leaning on the camera) here directs the photography of a scene from Korda's *Lydia*, showing Merle Oberon in a close-up. Notice the large crew, the amount of equipment necessary—the metal track for the "dolly," the "dinky" spot attached to the camera, and the overhanging microphone
Photo, Coburn



MEASURING THE CLOSE-UP. Part of the assistant cameraman's job is to measure the distance between camera and subject for a close-up. Here is Deanna Durbin being "taped"
Photo, Universal

story ideas, direction, and performances to the screen and for enhancing them all by every means at his command. Make no mistake, it's a big job, and one which is never finished, for no matter how carefully a scene may be planned, no matter how many times it may be rehearsed and photographed, the director of photography is always watching for ways to improve the result, and constantly making detail modifications in his treatment in order that the ultimate result may be as nearly perfect as possible.

In all this, he must be constantly thinking of each scene, not merely as an individual pictorial bit, but in its relation to all of the other scenes in the picture. Two scenes made weeks or even months apart may, when the picture is completed, follow each other in direct cuts on the screen. Therefore, those scenes must match. They must be alike in photographic quality. They must be shot from properly coordinated angles so that the flow of action from one to the next will be smooth. They must look as though they belonged together and had been made at the same time. Therefore details of lighting, composition, and so on must be uniform. Tricks of lighting, composition, or camera placement can never be considered solely on their individual merits, but in their re-

lation to the treatment of the adjacent scenes. A definite continuity of lighting, of composition, of camera angles—even of exposure—must be planned and adhered to.

It may be mentioned in passing that producers and directors who have made pictures abroad are unanimous in agreeing that our American cinematographers consistently achieve more perfect visual continuity than the cinematographers of any other foreign production center.

FOCUS AND EXPOSURE

While they may seem elementary from the professional's viewpoint, there are

a number of details of studio camera work which may prove helpful to the amateur and to the non-Hollywood professional. For this reason I ask the consideration of the professional reader while I comment on some of them.

Focus is a vital factor. It cannot be left to chance. Therefore it is a part of the routine of every scene and take for the assistant to measure the distance between the camera and the principal player, by using a tape measure. One end is attached to the camera, the other end is in the assistant's hand. After taking this measurement, the assistant sets the focus according to the calibrations on the lens. If there is any disagreement between visual focus as seen on the camera's groundglass and the measured distance, the tape measure is considered as correct.

This question of focus becomes complicated when the actors or the camera or both move around the set. With each important move, the focus must be changed. This is part of the first assistant's job. He watches the action and follows focus accordingly. Some complicated dolly or crane shots have involved as many as 50 changes of focus in a single shot! With some cameras the assistant follows focus by directly manipulating the focus controls on the camera;

with others, an electrical remote-control focusing mechanism is provided.

Exposure on interior scenes is generally governed by a combination of experience and the use of a photoelectric meter. The average professional cinematographer is a man who has spent 20 or 30 years photographing motion pictures. That experience has trained his eye to the point where he can visually "read" lighting levels and lighting balance as easily and accurately as the layman reads a printed page. None the less, working under the pressure of modern production conditions, the element of visual fatigue is sometimes a factor to be watched. This is especially true with our super-fast modern films, which are sensitive to very delicate gradations of lighting.

For this reason an increasing majority of the directors of photography make use of some form of photoelectric light-measuring device as a guide. On interior scenes, the general practice is to place the meter in the subject position and take an incident-light reading on the key light, or the principal light illuminating that player. All the rest of the lighting is balanced to this key light. Therefore if the key light is maintained at a correct intensity, the rest of the lighting, balanced to it visually, will almost inevitably be correct.

On exterior scenes the meter is generally used in the more conventional manner, for reflected-light readings.

It may be mentioned, too, that on interior scenes the general practice is to photograph everything at a fixed lens aperture, balancing the light level to this, rather than adjusting the stop to the illumination. Generally, this stop is full aperture or very near it, ranging from $f/2.7$ to $f/2.3$, though some individuals and at least one studio make it a practice to utilize some of the speed of modern film by stopping down to $f/3.5$ or thereabouts to obtain greater depth of field. Due to variations in film processing standards and to individual methods of light balancing, there is no set standard of illumination intensity.

Each cinematographer uses the lighting level he considers best adapted to his own methods and laboratory conditions. Therefore while surveys of lighting levels con-

ducted by the American Society of Cinematographers show the industry-wide average to be 114.57 foot-candles at $f/2.6$, the same surveys show that individual lighting levels range between a low of 38 foot-candles at $f/2.3$ with shutter opening reduced from 170° to 150° (cutting exposure time from $1/51$ second to $1/57$ second) and a high of 290 foot-candles at $f/2.9$. *Yet, it must be stressed, despite this extreme variation in illumination,*



OVERHEAD LIGHTING. For this interior scene, most of the lighting came from lamps overhead and the two lamps at the side of the camera were adjusted for close-ups

both cinematographers were obtaining thoroughly satisfactory results on the screen, because their lighting was correctly balanced and coordinated with the processing of the negative.

PHOTOGRAPHING OUTDOORS

On exterior scenes, the professional follows methods diametrically opposite to the usual amateur or commercial procedure. Outdoors, where there is an overabundance of light, the amateur or commercial photographer stops down his lens. The studio professional strives to avoid this, shooting with as large an aperture as possible and controlling exposure by reducing the shutter-aperture,

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by the use of neutral-density filters, and the like. There are two reasons for this, both tied to the need for keeping the photographic quality of interior and exterior scenes as uniform as possible. Stopping down a lens results in increased depth of field, which may not always be dramatically desirable, especially in the closer shots, as it tends to make the background intrude on the action. Secondly, stopping down tends to increase contrast. This is obviously undesirable in scenes that are to be inter-cut with interiors filmed at full aperture and lit for soft, pleasing gradations.

In filming exterior scenes, the professional makes use of three light-controlling methods, two of which the amateur can often also use to great advantage. The first of these is the use of reflectors to reflect diffuse sunlight into natural shadows, making the shadow—while still a shadow—more open and natural. These reflectors are large plywood flats surfaced with tinfoil or aluminum paint, depending upon the strength of reflection desired. They are placed in position about the subjects at the proper angles to reflect their “hard” or “soft” beams into the de-

sired places. The effect desired is seldom one of obvious reflection. Instead, it should be merely a soft equalization of shadow-illumination — never obvious. Frequently the “hard” reflectors are used to provide back or rim lighting to outline the face or form of a player actually in the shade. To an increasing extent, cinematographers are using their reflectors from high angles, placing them on parallels or platforms from 3 to 6 or more feet above the ground. This throws the light in from a more natural angle.

The second is the use of “booster lights” either to supplement or to replace reflectors. These are simply regular studio lighting units used outdoors. Sometimes they are used merely to fill in shadows softly, in place of reflectors. In other instances, especially when working with the subject in the shade, they are used to provide modeling lighting much as they would be used on a studio stage. Properly used, “booster lighting” can do a great deal to improve the quality of intimate exterior scenes.

Using “boosters,” the professional has of course the advantage of being able to take his own power supply with him in the form



OUTDOOR LOCATION. This location shot, taken in Albemarle County, Virginia, involved the use of a large scrim, reflectors, and a booster light (beyond the umbrella). Thus the light was carefully controlled—a necessity, especially when shooting in Technicolor as shown here

Photo, Paramount Pictures



BACKLIGHTING A SCENE. For the Technicolor movie, *Shepherd in the Hills*, this quiet fishing scene was taken. The backlighting is real, but is helped by the use of a booster light. Notice the script girl in the foreground Photo, Paramount Pictures

of a high-capacity portable gasoline motor-driven generator, or to cut in to existing utility high-tension transmission lines where they may be handy. The non-professional can hardly do this, but wherever he has electric current available near his exterior locations, he will do well to utilize "boosters."

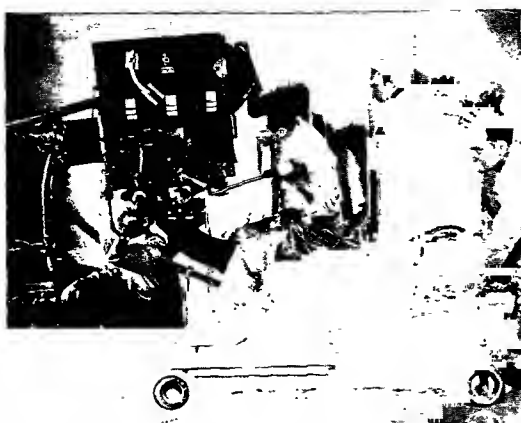
The third method is one which is possible only to one who has the resources of a studio production unit available. It is the use of overhead scrims to diffuse the direct rays of the sunlight, making the lighting softer and more pleasing. This is done by stretching diffusers of multiple-layered netting or white muslin between the subject and the sun. Sometimes these scrims are of relatively small size and supported on poles so that they diffuse the light only on the principal players. At other times, the scrims are large and suspended overhead like a flat circus tent, to cover completely a whole exterior set.

Some of the latter have been as large as 80 x 200 feet in size. In some instances, working on exterior sets built on the studio lot, cinematographers will scrim the set very heavily, so that only a very soft, over-all illumination is transmitted, and thereafter produce modeling lighting with artificial sources exactly as though the scene were an interior on the stage.

To a certain extent the non-professional can emulate this scrimming technic if he cares to use the large, circular diffusers made for daylight portrait galleries. With such a scrim, he can diffuse the light on at least his principal players in close shots and, producing modeling lighting with reflectors or boosters, obtain much more flattering results.

USE OF FILTERS

Filtering on professional exterior scenes is a delicate matter. There must be a definite



DOLLY. Tripods are almost never used in professional movie making. Instead, the camera—in a soundproof "blimp"—is mounted on this crane-like wheeled support, called a "dolly"
Photo, Twentieth-Century-Fox

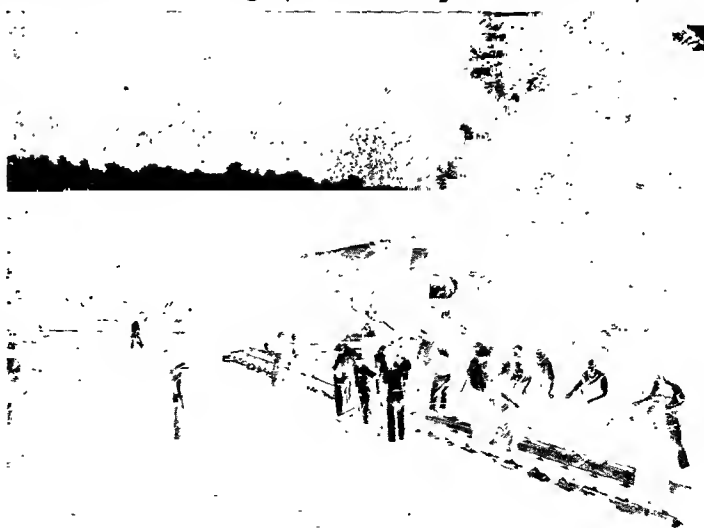
continuity to filtering, as well as in lighting, composition, exposure, or camera angles. A scene in any story-telling picture must be considered not merely as an individual pictorial unit, but in relation to the related scenes and to the people carrying out the dramatic action. Filtering which might be individually effective in portraying the scenery alone may often be undesirable when its effect upon the people, their face tones, and the rendition of their costumes is considered. In general, with the inevitable exception of filtered night effects, professional filtering is usually on the conservative side, with such moderate correcting filters as the Aero 1 and 2, the G, the 21, and the like.

Many cinematographers follow a definite continuity in filtering as the camera approaches the people more closely. They will use a comparatively heavy filter on the longshots, and progressively lighter and lighter ones as the action works inward to medium-shots and close-ups. Obviously this requires a very precise knowledge of filters and must be done deftly, so that the results on the screen will not

show a sudden change in filter or correction with each change in camera angles.

Diffusion is another detail which must be handled with precision. It may be surprising to the non-professional to learn that few, if any, Hollywood scenes are shot without some form of optical diffusion. But this diffusion is a very different thing from the "fuzzygraph" diffusion of 10 or 15 years ago. It is, instead, an almost imperceptible softening of the wiry-sharp definition of our modern anastigmat lenses, which actually "see" things sharper than the best human eye does. Furthermore, an almost imperceptible diffusion is an important part of glamorizing sets and people, for the diffusion tends to conceal minor imperfections which the camera might reveal.

The degree to which diffusion has changed is perhaps best illustrated by the changing standards of a typical line of diffusing filters. When these filters were first brought out nearly two decades ago, 4 degrees of diffusion were provided, numbered from 1 to 4, with the largest number indicating the heaviest diffusion. Today, we seldom hear of these numbers. Instead, the most frequently used numbers in the line are those bearing fractional numbers! As diffusing technic changed, first a No. $\frac{1}{2}$ was demanded, then



TRUCK SHOT. It took twelve men to pull this camera truck, weighing 650 pounds. Notice the long track (only one-third of which is shown) used for a moving camera shot in the Technicolor production, *Virginia*. Movement of the truck during a shot must be extremely silent and smooth
Photo, Paramount Pictures



STAIR SHOT. In the opening scene of *Three Smart Girls Grow Up*, the camera followed the heroines along a balcony and down a flight of stairs. Here are director Henry Koster (left) and cinematographer Joseph Valentine, A.S.C. (left, behind camera) as they ride the huge crane
Photo, Universal

a No. $\frac{1}{4}$, followed by No. $\frac{1}{8}$, and so on until now No. $\frac{1}{64}$ and No. $\frac{1}{128}$ are in common use!

The amount and type of diffusion necessarily depends upon the dramatic type of the story. A tragic love story will as a rule call for heavier diffusion than, say a melodrama. A light comedy will call for diffusion unlike that of a slapstick comedy. And a film like *The Grapes of Wrath*, cast in an ultra-realistic mood, will demand a minimum of diffusion, so that the realistic approach may be maintained.

In the same way it will be obvious that a masculine player like Clark Gable, who is to express rugged virility, will require virtually no diffusion, while a glamorous feminine player like Hedy Lamarr will be benefited by moderately strong diffusion.

Diffusion must obey the canons of continuity, too. It is extremely bad cinema-

tography to have a heavily diffused scene pop up suddenly in the midst of a sequence shot with little diffusion. The days when every close-up of the heroine was automatically shot through layers of diffusion-producing gauze are gone forever.

Most cinematographers practice a definite continuity of diffusion with changing camera angles, too, using relatively less diffusion on the longer shots and more on the closer angles. But, like almost every other trick of cinematography, this progression must never appear obvious on the screen.

THE MOVING CAMERA

The use of the moving camera technic has vastly complicated the problems of modern studio cinematography. Lighting and composing a shot in which the camera may have to travel all around a big set, and doing it so

THE COMPLETE PHOTOGRAPHER

that every frame of film will show a pleasing composition and the set and players will be favorably lighted at all times, cannot help but be incredibly complicated.

But it must be admitted that this technic has brought about some advantageous mechanical developments. A considerable variety of mobile camera supports—dollies, booms, and small and large cranes—have been developed. It has been found that these, in the smaller and middle-sized crane units especially, are a much more efficient camera support for all-around use than the conventional tripod. If, for example, between one scene and the next it is desirable to move the camera a foot or so to left or right, or to place it a few inches higher or lower, it is much easier and quicker to simply swing a crane arm to the desired position than it is to move and adjust any type of tripod. In the same way, a camera set-up in a cramped corner of a set, or overlooking a table, or the like, can be made much easier—and with much greater precision—by one of these devices. Obviously, too, it is easier to place

the camera in any unusual position—low or high—with one of these cranes than by transferring the camera from its tripod to a baby tripod or “high hat” for low angles, or hoisting camera, tripod and all up onto a parallel for a high angle.

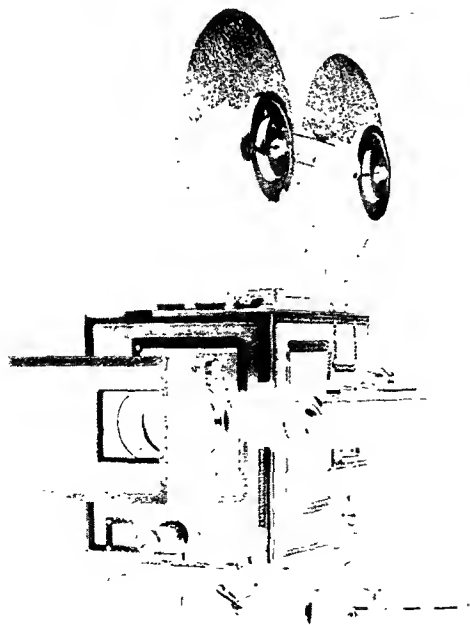
COLOR CINEMATOGRAPHY

Color cinematography has established itself firmly in the industry and it seems inevitable that as the various color processes available improve and become simpler and more consistent, color will play a larger part in studio camera work.

At present, the only 35mm color process available is Technicolor. This is a three-film process which works a good deal like a motion picture version of a still photographer's one-shot color camera. In it, three separate films pass through the camera. By means of reflecting prisms and selective filters, the image cast by the lens is broken up into the three necessary to produce the three color-separation negatives which respectively record the primary color components of the scene. (See article on *Color Movies*.)

Each of these three films is then developed as a black and white negative, receiving, of course, scientifically coordinated development. The printing is done subtractively, by a process that may be compared roughly to lithography or to wash-off relief. From each of the three negatives a matrix is printed, using a strip of film identical with the dimensions of ordinary motion picture positive, but so treated as to produce its image in relief. Each matrix is then impregnated with a dye of a color complementary to that of the filter used in making the separation negative from which it was printed, and the dye-impregnated matrix is brought into contact with a strip of positive film called a “blank,” upon which the sound track and a faint black and white key picture-image have been printed photographically. In this operation, the dye transfers from the matrix to the blank. When the three successive dye-transfer operations with the three matrices have been completed, a three-color positive print results.

The purely photographic side of color cinematography is simple. With the excep-



TECHNICOLOR CAMERA. This big three-color motion picture camera is a remarkable precision instrument. Notice the huge film chambers, capable of holding the three film rolls

tion that lighting can be and usually is much softer and flatter than in black and white (since color contrasts can in a great measure take the place of lighting contrasts in producing separation of planes), the general technic of Technicolor cinematography does not differ markedly from that of monochrome.

In all color cinematography, however, the color of the lighting has an important effect on the results obtained. In the still and amateur processes like Kodachrome, Dufaycolor, etc., this is usually compensated by either using a special type of film, chromatically balanced to the color of the lighting used (like the Type A Kodachrome for photoflood and the Type B for ordinary Mazda lighting) or by using compensating filters in the camera. In Technicolor, however, it has been considered more practical to correct the color of the light itself, to produce light of a neutral white tone closely comparable to daylight. For this, specially developed arc lighting units are generally used, though recently cameramen have used high-powered photoflood Mazda globes (known as the "CP" type) further compensated by special daylight-blue filters used over the lamps. Both of these artificial light sources so successfully match the color of daylight that they can be used in conjunction with natural light as boosters.

PROSPECTS IN CINEMATOGRAPHY

In closing, let me say a few words to the hopeful non-professional about the prospects of making studio cinematography a career. At present, studio camera work, like many another profession, is badly overcrowded. For many years this has been the case. The camera profession has for a long time been an attractive, interesting, and well-paid one; inevitably it has attracted men from all over the world to Hollywood—experienced professionals and hopeful young novices alike.



RAINY DAY. In the Warner Brothers-First National picture *Sergeant York*, this rainy day scene of Gary Cooper on muleback was shot. Notice the protection given the camera and crew, the thorough soaking given the hero

Overcrowding was the result. When sound came in, this situation was made worse by the early necessity of using a great number of cameras at a time, to secure every possible angle of a scene at a single take. This practice has long since been eliminated, but the extra supply of talent thus created still remains. Further, during recent years there has been an increasing effort to avoid seasonal rush periods, stabilizing the industry's personnel needs.

Some day, undoubtedly, there will be evolved a system of apprenticeship or similar training by which new cinematographers can be trained and assured of a place in the industry. But none of us can say when that day will be. At present, the technical and economic responsibilities entrusted to the director of photography and his crew are so increasingly great that only the trained man—the man with 5, 10, or 20 years of practical production experience—can be considered safe for the job. For, as mentioned previously, if the man at the camera misses, the whole vast outlay of thought, effort, and money which go to make up a production is wasted. It *must* pass through the camera to reach the screen and the paying public. That it does this with such a consistently high record of success, is in itself a tribute to the men behind the camera.

CIRCLE OF CONFUSION AND DIFFRACTION DISC

H. W. Zieler

President, E. Leitz, Inc., New York

In the field of photographic optics, the subject of the circle of confusion and its relation to image sharpness is an important one. This is a thorough scientific study of a rather complicated subject—complete with diagrams and formulas. Every photographer is urged to read it, for here is real information on the action of light, on diffraction, depth of focus and depth of field, relation of f-value to image sharpness.

All diagrams by H. W. Zieler
See Also *Lenses and Their Characteristics*

EVERY photographer will find out sooner or later that there is a limit to the capacity of the photographic process for reproducing in the picture the finest detail which is present in the object. Before the advent of the miniature camera, the photographer used a negative mainly for making contact prints, and, therefore this limitation was of relatively little practical significance. But even at that time we find evidence of the desire to obtain pictures in which even the finest detail of the object was reproduced. Those photographers whose pictures were exceedingly sharp were often referred to as belonging to "the f/64 school." Behind this reference we find the vague implication that by *stopping down* the lens as much as possible, the sharpness of the picture could be increased. Since precision miniature cameras have come into general use, it has become

common practice to make huge enlargements from small negatives, and in step with the general progress in the entire field of photography, all problems pertaining to the technique of producing the sharpest possible negative have gained in importance.

The method of trial and error to which many photographers have adhered in attempting to produce sharper negatives, is somewhat tedious, and an understanding of the *theoretical* problems is of distinct *practical* advantage to the photographer. The following explanations of some relatively dry and abstract optical and physical principles are offered with the desire to help the photographer in his efforts to produce sharper negatives.

It seems advisable to mention in the beginning that the performance of the lens in forming the image is, of course, a very important factor, but it is not the only one which contributes towards the production of a sharp *negative*. It must be realized that we face two distinct problems: 1. that of the formation of as perfect an image as possible by the lens; 2. the recording of this image on the negative. After having discussed the optical principles concerning the reproduction of detail in the image *which the lens has formed*, it will be necessary to draw attention to the limitations of this process of *recording the image on the negative*, a process in which a considerable amount of the detail of the image as produced by the lens may very easily be lost.

(Continued on page following insert)

COMPOSITION ANALYSIS for . . . LAUNCHING A FERRY

The character of this picture is action. But action alone cannot account for the effect of tremendous power. Other ingredients are required. There are two that may be considered of outstanding importance. One is cause, the other consequence. Over on the right one sees the blocks giving way to the eight thousand ton hulk sliding into the water. Over on the left, reaching nearly into the center of the picture, the mass of water reacts violently to the terrific impact.

It is this theme of tilted blocks, slanting hulk, retreating water, all in a right-to-left motion, which creates the impression of great power. Neither the foreground nor the background is needed to support or strengthen that impression. The continuity of action is sufficient.

Which is not to say that one may not find helpful notes, for instance, in the smooth, even character of the water in the foreground contrasted against the turbulent violence of the deluge farther back. Or the black shadow of the bulk making the white foam appear even whiter. There, too, is the crane in the background whose direction parallels the right-to-left movement of the action. The undisturbed tree in the foreground stands out with quiet conviction against the picture of cold brutal force. If a critical note be permitted, the toll building in back of the ship is in the way. Also, clouds would add to the vividness of the scene.

Konrad Cramer





LAUNCHING A FERRY

HARRIS W. NOWELL

The world's biggest car ferry, City of Midland, being launched in Manitowoc, Wisconsin. DATA: Speed Graphic 4 x 5, fast pan film, 1/800 second, f/11
Photo from, The Milwaukee Journal



ABBOTSBURY SWANS

W. SUSCHITZKY

In the well-known swannery at Abbotsbury, England, these long-necked and white swans were found. The nest is a high domed structure made of dry reeds. Here the darker surroundings are well contrasted with the white and feathered texture of the birds themselves



ABBOTSBURY SWANS

W. SUSCHITZKY

These two proud swans have nested in the garden of Abbotsbury's swanherd for many years. An interesting picture of the birds' family life, as well as one of beautiful composition. These birds, somewhat tame after many years of nesting in the same spot, are easy to photograph



WARSAW

ROMAN VISHNIAC

In the Ghetto of Poland's capital city, this photograph was taken. Very much a "mood" picture, it makes good use of the dreary buildings, the falling snow, the wet and dirt of the streets, the bent man in the foreground. An interesting pictorial and somewhat reminiscent of Leonard Misonne—except that there are no signs of control whatever on the print

CIRCLE OF CONFUSION AND DIFFRACTION DISC

(Continued from page preceding insert)

REFRACTION OF LIGHT

The formation of an image of an object by a lens is based on the optical phenomenon of *refraction of light*. When you hold a straight rod so that it is partly submerged in water, it looks as if that part of the rod which is under water is bent. This is due to the fact that when light passes obliquely from one optical medium (for instance air) into another one of different optical characteristics (for instance water), it suffers a change of direction, it is *refracted*. This is illustrated in Figure 1. For the simplification of the following explanations, it is advisable to recall to the reader's memory a few simple optical terms. In Figure 1, a ray of light *A* travels in air or any other transparent medium and meets the surface of another medium (for instance glass) at *B* under the angle of incidence *i* which is always measured from a straight line *C-B* vertical to the surface. This ray proceeds in the new medium, glass, in a new direction. The angle *r* is the angle of refraction. Through numerous experiments the physicists discovered a definite law which clearly defines this change in direction of light rays as they pass from one optical medium into another one, and which enables us to determine by calculation the new direction of the refracted ray for every angle of incidence, if we know certain optical constants of the two optical media (for

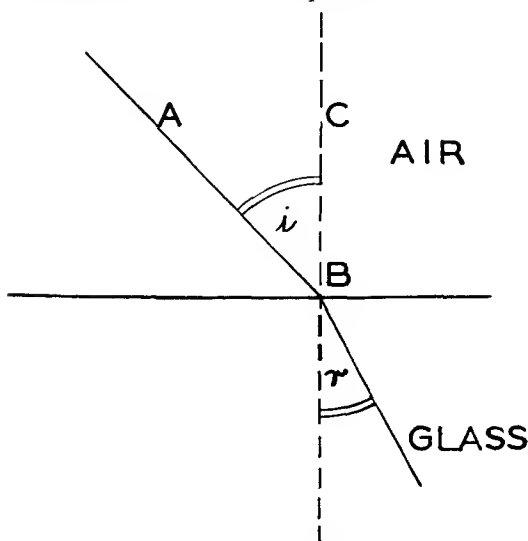


FIG. 1. REFRACTION

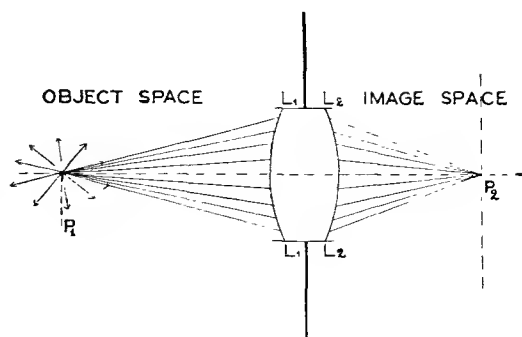


FIG. 2. FORMATION OF AN IMAGE

instance air and glass). These constants are called refractive indices.

FORMATION OF AN IMAGE

For the explanation of the formation of an image by a lens system, we may select the simplest possible object, a single luminous point, remembering that an extended object may be considered as an assemblage of separate luminous points. In Figure 2, light proceeds from this luminous point *P*₁, in all directions, and some of the rays have been indicated in this diagram as straight lines. At a certain distance from this point *P*₁, we can place either one or several pieces of glass of definite predetermined shapes. The end surfaces of this compound body of glass are shown in Figure 2 as the two curved lines *L*₁ and *L*₂. Each ray coming from point *P*₁ which passes through these bodies of glass changes its direction depending upon the angle of incidence under which it meets the various surfaces. By skillfully shaping these surfaces of the glass bodies, by selecting for each one of them a glass of suitable refractive index, and by placing them at accurately predetermined distances from each other, the lens maker tries to change the directions of all of these rays in such a manner that finally all of the emerging rays converge and pass through another single point *P*₂, which is called the real image of *P*₁.

If light rays were comparable in every respect to straight lines, and if we were 100% successful in guiding these rays to one single point, the capacity of the lens to reproduce the minutest detail of the object in the image would be unlimited. Unfortunately, we are neither 100% successful nor are light rays in every respect comparable to

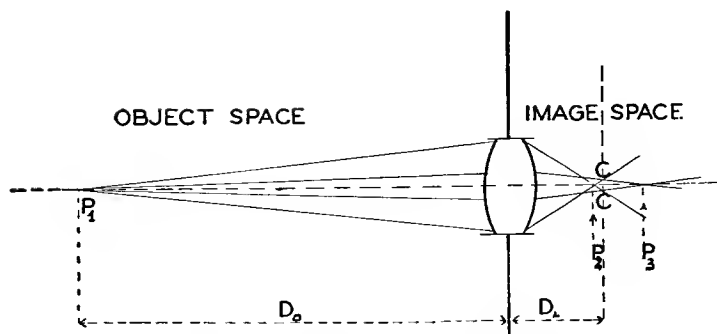


FIG. 3. THE CIRCLE OF CONFUSION

straight lines. Let us investigate at first how closely we can approach with all resources of scientific calculation and technical manufacturing skill the theoretically perfect condition of guiding the rays from one object point to one single image point.

CIRCLE OF CONFUSION

Figure 3 illustrates one of the difficulties which we will encounter. The lens has succeeded in making the divergent rays (coming from point P_1 at the distance D_0) to converge in the image space, but they do not unite in one point. The rays which pass through the outside portion of the lens have suffered too much of a change of direction and unite at point P_2 , which is relatively close to the lens. The rays which have passed through the center portion of the lens unite at point P_3 which is farther away from the lens. If we should place a projection screen or a groundglass somewhere in the image space and relatively close to the lens, we would see a disc of light. By moving the screen farther away from the lens, the diameter of this disc of light would decrease to a minimum when the screen is at the distance D_i , and from then on it would increase again.

The best we can do is to reproduce a single point P_1 as a small circle of light of the diameter $C-C$. We cannot entirely eliminate the confusion which has arisen because the rays fail to do what we expect. Thus, we find that the image of a point is a circle of confusion, and all we can do is to aim towards making the diameter of this

circle of confusion as small as possible.

REDUCING SIZE OF CIRCLE OF CONFUSION

How can we do that? The simplest way seems to be for us to eliminate the rays which pass through the outside portion of the lens system. The photographer knows that the lens of his

camera has an iris diaphragm. Obviously, therefore, we only have to close the iris diaphragm in order to reduce the diameter of the circle of confusion, or, in other words, to increase the sharpness of the picture. Of course, this is a conclusion which we draw at a point of our explanations when we are not yet fully familiar with the behavior of light rays. Later on, we shall see that this procedure of closing the iris diaphragm introduces new obstacles interfering with our desire to produce sharp images. But even now we may remind the photographer that by closing the iris diaphragm, we admit less light to the lens system, and, therefore, we must increase the time of exposure, thus losing the opportunity to snap many a candid shot.

But the problem of the circle of confusion has other ramifications.

If we had created a lens system of acceptable diameter which reproduces point P_1 in Figure 3 as an extremely small circle of confusion, are we justified in rejoicing? In order to answer this question, we examine what happens if we use the same lens system to form an image of another luminous point

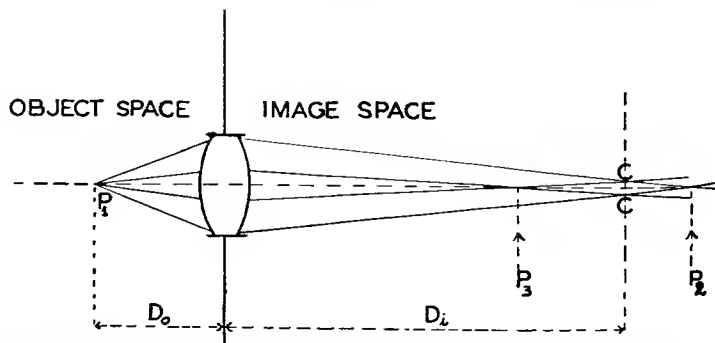


FIG. 4. THE CHANGING SIZE OF THE CIRCLE OF CONFUSION

which is much closer to the lens. Practical measurements of the size of the circle of confusion may indicate that it has not increased very much, but a close study of the passage of all rays through the lens reveals the conditions shown in Figure 4. The rays passing through the outside portion of the lens meet the surface under a greater angle of incidence, and, consequently, the directions of the refracted rays change so that the outside rays unite at point P_2 farther away from the lens than P_1 , where the inside rays unite. If the luminous point is still closer to the lens, the diameter of the circle of confusion will increase further.

SPHERICAL ABERRATION, RELATION TO CIRCLE OF CONFUSION

It is quite evident that from our point of view, these light rays make errors in traveling through space or, to use optical language: After passing through the lens system, the light rays are subject to *spherical aberration*. If the lens is so constructed that the spherical aberration is reduced to a practical minimum, we say that the lens is spherically *corrected* or *aplanatic*.

We can now condense our knowledge into the following deductions:

1. The circle of confusion is created by spherical aberration.
2. The diameter of the circle of confusion is directly indicative of the amount of spherical aberration of a lens system.
3. The smaller the circle of confusion, the better is the spherical correction of a lens.
4. The diameter of the circle of confusion of a given lens system *is not a constant*, but it varies with the distance from the object point to the lens. That means that a lens system cannot be equally well corrected spherically for all possible object distances.
5. The diameter of the circle of confusion of a given lens system *increases* with *increasing* effective diameter of this lens system, because the spherical aberration increases.

THE PHYSICAL NATURE OF LIGHT

At this point, we must remember that we based our conclusions so far on the rather superficial observation that light rays are comparable to straight lines. On the basis of this assumption, it appears as if there were

no limit to the possibilities of improving the capacity of the lens to reproduce the minutest detail except the limitations of our own skill in designing and manufacturing lenses which guide light rays from one object point to one image point. If we study the *physical nature of light*, we must revise our deductions.

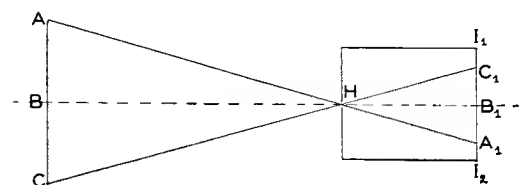


FIG. 5. DIAGRAMMATIC ILLUSTRATION OF IMAGE FORMATION

In order to find out if we are really justified in assuming that light rays are comparable in every respect to straight lines, we conduct an experiment with the so-called pinhole camera. We build a camera which has a small pinhole in the front board instead of the lens (see article on *Pinhole Cameras*). It is our aim to permit only one ray from each object point to contribute to the formation of its image.

Figure 5 illustrates diagrammatically this process of image formation. Only one ray from point A of the object $A-B-C$ passes (theoretically) through the hole H of the camera onto the screen, groundglass, or photographic plate in the plane I_1-I_2 which it meets at the image point A_1 . The same applies to single rays from each other object point, for instance, from B to B_1 , and from C to C_1 . Thus, we have in the plane I_1-I_2 an image of the size A_1-C_1 of the object $A-C$. Our success in producing a sharp image seems to depend entirely upon how small a hole we can drill into the front board of the camera.

If we drill a very small hole into the front board of the camera—perhaps 1/500 inch in diameter—we ought to expect quite a sharp image, but actually we will find on the photographic plate a strange mix-up of darker and lighter areas where detail of the object is no longer recognizable. What has happened? In the first place, the result of the experiment shows that our assumption that light rays are comparable in every respect to straight lines, was *wrong*. We have found out

what light rays are *not*. They are *not* comparable to straight lines. But what *are* they? What is the real physical nature of the process of propagation of light, and how can we find an explanation of the phenomena produced by light? We have to travel a long and tedious path to find answers to these questions, but only by investigating the true physical nature of light will we discover that something which we may call *the structure of*

light sets a limit to the sharpness of the images which lenses form, and this physical limit cannot be overcome even by a theoretically perfect lens.

WAVE MOTIONS AND DIFFRACTION

Certain experiments which scientists have conducted indicate that some phenomena produced by light have great similarity to phenomena produced by other forms of energy under similar conditions. Therefore, we temporarily turn our attention away from light and conduct a few experiments with another medium of energy—namely water.

The undisturbed surface of water in a large tank is as smooth as a mirror. If we drop a stone into the water, waves are emanating from the center of disturbance in all directions on the surface of the water which we see as circles of ever increasing diameter. As these waves move with a certain speed away from the center of disturbance, each point of the surface of the water moves

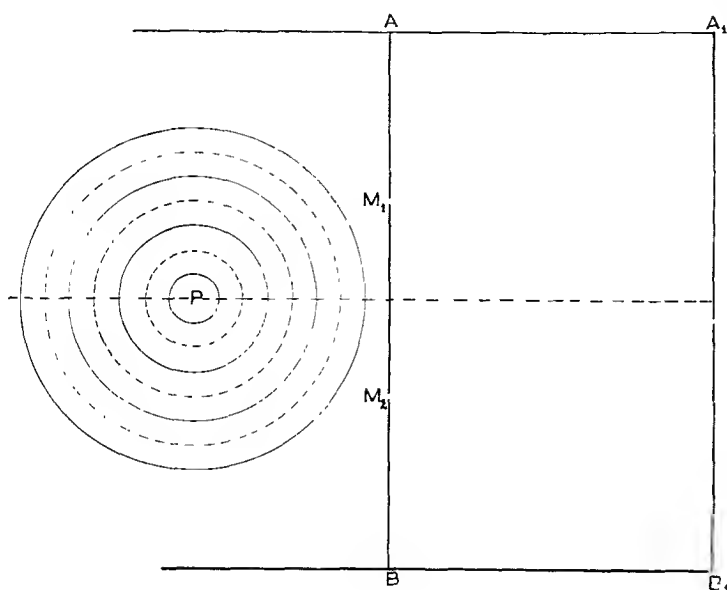
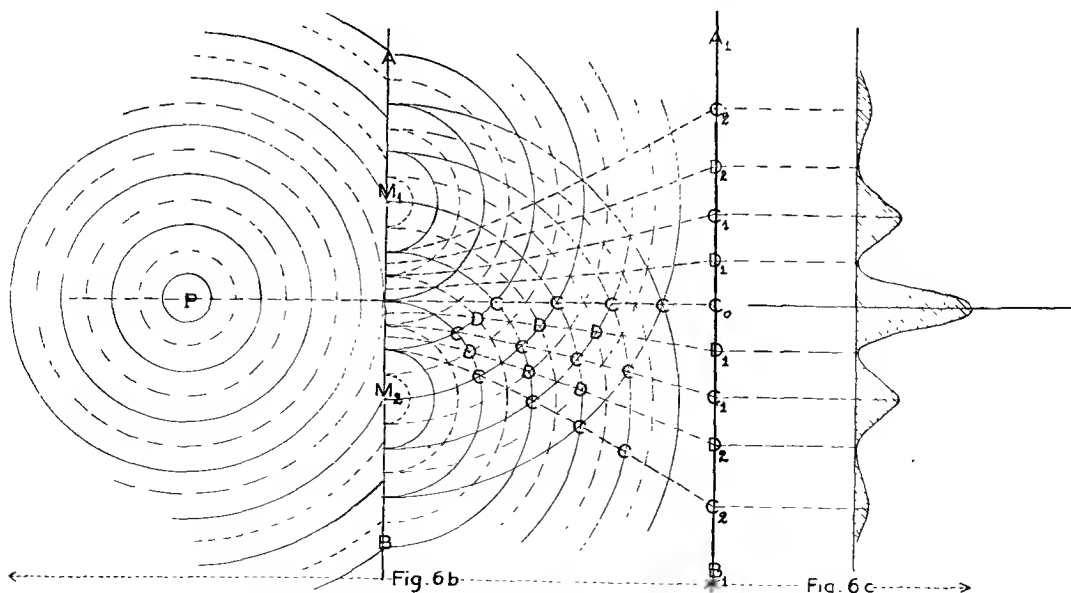


FIG. 6a. WAVE MOTION



FIGS. 6b and 6c. DIFFRACTION AND INTERFERENCE

CIRCLE OF CONFUSION AND DIFFRACTION DISC

only up and down. For instance, a small piece of wood swimming on the surface at a certain distance from the spot where the stone dropped, will retain this distance, but as wave after wave passes by, this piece of wood is lifted up by an approaching wave crest, and then pulled down into the wave trough.

Now let us suppose that we place into the tank a wall with two holes in it as shown in Figure 6a. Point P indicates the spot where the stone dropped into the water. The fully drawn out circles are the wave crests, and the dotted circles are the wave troughs. The separating wall $A-B$ has two slots at M_1 and M_2 . Figure 6b shows the conditions a few seconds later. The waves have reached M_1 and M_2 , and these two points have now become centers of new wave motions which spread out in perfect synchronism with the original wave motion as indicated by the semi-circles behind the wall $A-B$. The distances from crest to crest (called the wave lengths) have remained the same, but the intensity of the wave motion, the amount of up and down movement of the surface (called the amplitude), has decreased considerably.

It is evident that as these two wave motions spread out, they clash. Let us examine what happens. You see from Figure 6b that at all points marked C a wave crest from M_1 arrives at the same time as a wave crest from M_2 . Each wave crest separately would be capable of lifting a small piece of wood at C in an upward direction. The two energies of these wave motions at C act in the same direction. Therefore, they combine their efforts and lift the piece of wood as much upward as the sum of the two amplitudes. A short time interval later, 2 wave troughs have arrived at C , and, therefore, they pull the piece of wood downward. Then 2 wave crests come and throw the piece of wood upward again. Therefore, at all points C we have a wave motion of an intensity equal to the combined effects of the two separate wave motions from M_1 and M_2 .

Other pieces of wood may be swimming at points marked D where a wave crest from M_1 arrives simultaneously with a wave trough from M_2 . These pieces of wood find themselves in a dilemma. The wave crest

from M_1 wants to push them upward at the same time as the wave trough from M_2 tries equally hard to pull them downward. Result: The two forces of equal magnitude act in opposite direction, and they cancel each other. At all points D the surface of the water remains as if there were no wave motions at all.

The entire process can be described as follows: The energies of the original wave motion at points M_1 and M_2 have been scattered or *diffracted* into new wave motions which *interfere* with each other. At all points for which the distance from M_1 is either equal to that from M_2 or one full wave length (from crest to crest) longer or shorter than from M_2 , the interference causes the wave motions to *reinforce* each other. In other words, we have an interference *maximum*. (The same applies for all points for which the difference in distances from M_1 and M_2 is 2, 3, 4, 5, or any multiple of a full wave length.) On the other hand, we find that at all points for which the difference in distances from M_1 and M_2 is *one-half of a wave length* (from crest to trough), the wave motions cancel each other. In other words, through *interference* the total energy of the two wave motions has been reduced to a *minimum*. (The same applies to all points for which the difference in distances from M_1 and M_2 is $3/2$, $5/2$, or any odd multiple of half a wave length.)

At the back wall A_1-B_1 of the tank we see evidence of these interfering wave motions as a wavy profile of the water line. At points C_0 , C_1 , and C_2 , etc., we have interference maxima where wave crests have pushed the water line *up* (and troughs—*down*), whereas at points D_1 and D_2 , the wave motions have cancelled each other and the water surface stayed at its normal level. At these points we have interference minima. The wavy water line on the vertical wall A_1-B_1 is shown diagrammatically in Figure 6c. The essential part of this story is:

1. Each point of the wave front of a wave motion can become the center (M_1 , M_2) of a diffracted wave.

2. Diffracted waves can interfere with each other and create in any given plane ($A-B$) a certain definitely determinable *interference pattern*.

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THE INTERFERENCE PATTERN

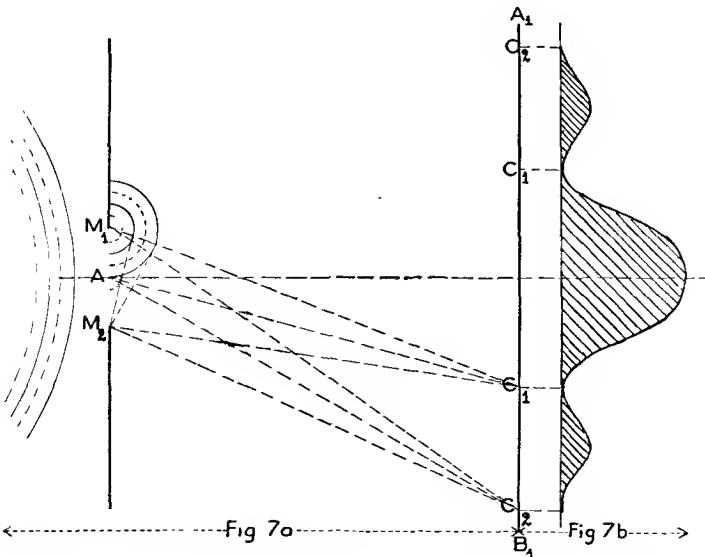
We are now in a position to predict the shape of the interference pattern in the plane A_1-B_1 of Figure 6b if we remove the wall between M_1 and M_2 . For instance, let us find the result of all interferences of diffracted waves at point C_1 where we had an interference *maximum*.

As shown in Figure 7a, if we divide the space between M_1 and M_2 into two halves (M_1A and AM_2) we can find for each point of the wave front in the first half M_1A another point in the second part AM_2 which is exactly half a wave length nearer C_1 . In Figure 7a, the distance M_1C_1 is one-half of a wavelength longer than AC_1 , and for all points on the line M_1A the distance to C_1 is one-half of a wave length longer than that from a corresponding point on the line AM_2 . In other words, all diffracted waves from the first half interfere with and cancel all diffracted waves from the second half, and at C_1 we now have an interference *minimum*.

Interference minima of higher orders occur when the total difference in distances: $M_1C_1 - M_2C_1$ is 2, or 3, or any full multiple of a wave length, because the total space from M_1 to M_2 can always be subdivided into 2, or 3, or any higher number of areas where a total phase difference of one wave length prevails, and where all waves of one-half cancel those of the other half. The inter-

ference minima of the second order occur at C_2 , etc., and between these minima we have interference maxima, so that the profile of the water line at the back wall $A-B$ would assume a shape shown in Figure 7b. Comparing this to Figure 6c, we find that the center interference maximum has widened, and that otherwise the location of maxima and minima is reversed. If we know the width of the aperture M_1-M_2 , the distance of this hole from the back wall, and the location of the interference minima and maxima on the back wall, we can definitely calculate the *wave length* of the wave motion which has produced this interference pattern. On the other hand, if we know the size of the hole M_1-M_2 , its distance from the back wall, and the wave length, we can calculate the location of the interference maxima and minima.

As long as we have dealt with water waves, it was easy for our imagination to follow each step of the analysis. We can actually see water waves, we can follow the entire progress of the diffraction so that our task of finding a key to the explanation of the final interference pattern is not so difficult. In the case of light phenomena, we can readily reproduce the experimental set-up, and we may come face to face with a final interference pattern, but in reconstructing the conditions which produce this pattern, we can not rely on direct observation, and we are compelled to resort to abstract calculations.



FIGS. 7a and 7b. INTERFERENCE MINIMUM AND MAXIMUM

DIFFRACTION DISC

In order to find out if light under similar conditions (as those of Figure 7a) can produce an interference pattern, we can set up an experiment so that light (of a definite color) from a point-shaped source passes through a slit of definite width onto a screen. We will see that there is an interference pattern. But instead of a curved *line*, it is an *area* of light and dark stripes running parallel to the length of the slit in which successive bright areas decrease rapidly in intensity. If the point-

CIRCLE OF CONFUSION AND DIFFRACTION DISC



FIGS. 8a and 8b. DIFFRACTION DISC

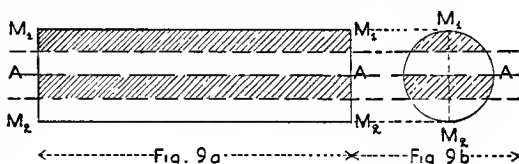
shaped source sends out *white* light, the interference pattern shows a series of rainbow colored strips arranged symmetrically at both sides of a center stripe of white light.

We are justified in trying to interpret this pattern on the screen as resulting from interference of wave motions, and if we know the width of the slit, the distance between the slit and the screen, and the location of the various colors of the rainbow strips on the screen, we can determine the wave length of each color of the rainbow, or *spectrum*. The wave length of the red color of the spectrum is about 0.000028 inches (700 millimicron), and that of the violet color of the spectrum about 0.000016 inches (400 millimicron), with all other colors of the spectrum (orange, yellow, green, blue, indigo) having intermediate wave lengths.

All of these explanations enable us now to analyze one particular interference pattern which is of great significance in the formation of images by lenses. Let us examine what happens if light from a single point and a single color of the spectrum passes through a *circular hole* of definite diameter instead of a slit of definite width. Figure 8a is an actual photograph (considerably enlarged) of the resulting interference pattern. A large central bright circular area is surrounded by rings of much weaker and rapidly diminishing intensity. Each one of these rings represents an interference maximum, and these successive maxima belong to *higher orders* (first order is first interference maximum, second order is second maximum, etc.).

The photograph 8a was used in preference to a drawing in order to establish a more definite link to reality, although it is well

known that a diffraction disc with *all* of its surrounding rings is practically unphotographable. The ratio of the central intensity to that of the outside rings is such that no photographic paper print will cover this range of intensity satisfactorily. Therefore, the first ring is completely "swamped" by the central image which has expanded because of extreme overexposure necessary to record the faint outer rings. Figure 8b, however, shows a normal exposure under identical conditions. We see that the ring-shaped maxima have practically disappeared so that we may consider the central disc as the image of a single point produced by the passage of light through a small hole. If we know the diameter of this hole, the distance to the screen, and the diameter of the central disc of the interference pattern, as well as



FIGS. 9a and 9b. CROSS SECTIONS THROUGH SLIT (left) AND CIRCULAR HOLE (right)

the wave length of the light which has produced this interference pattern, we can determine by calculation that the *interference minima do not occur exactly where they occurred when light passed through a slit*. We may remember that in the case of a slit the difference in distances from M_1 and M_2 in Figure 7a (which, incidentally, is called the phase difference), was exactly *one wave length* at the point C_1 where a minimum occurred. In the case of the interference patterns of Figures 8a and 8b, the first interference minimum occurs when the phase difference is slightly more than one wave length (about 1.22 wave length).

To explain this fact, we must compare the cross sections through a rectangular slit and a circular hole. In Figure 9a, we have a cross section through the rectangular slit M_1-M_2 of Figure 7a. The dotted line $A-A'$ divides the area of the slit into two halves, and each half is again subdivided into two quarters. For each point of the upper shaded area of Figure 9a we will find a point in the lower shaded area which (referring to Figure 7a) is

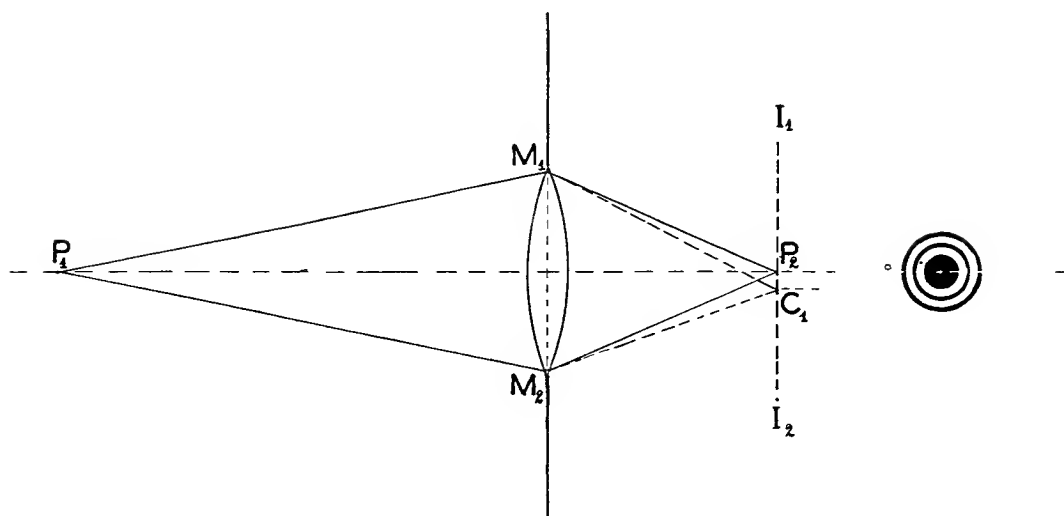


FIG. 10. FORMATION OF AN IMAGE POINT

exactly one-half a wave length closer to point C_1 , so that cancellation of the energies through interference results. (The same applies to the unshaded areas.) The four areas in Figure 9a are exactly equal in size so that complete cancellation of the entire energy which has passed through the slit occurs at point C_1 of Figure 7a as explained before on page 774.

In Figure 9b, we have a cross section through a circular aperture which is also subdivided into four areas; each area has a width of one-quarter of the diameter of the aperture. The conditions are almost identical to those of Figure 9a, except that the upper shaded area is smaller than the lower shaded area. Therefore, after the entire amount of energy passing through the upper shaded area has been cancelled through interference with energy from the lower shaded area at a phase difference of one-half of a wave length, there is still some energy left from the *larger* lower shaded area. (The same applies to the unshaded areas.) Therefore, when light passes through a circular aperture having the same diameter as the width M_1-M_2 of the slit of Figure 7a, complete cancellation through interference would not take place at a point C_1 for which the phase difference is exactly one wave length. However, it has been found that when light passes through a circular aperture, an interference minimum occurs at points for which the phase difference is about 1.22 wavelength.

Now let us suppose that we increase the diameter of the hole so much that we can insert a lens of a certain focal length which concentrates the light from one object point into an image point as shown in Figure 10. We still have to contend with phenomena caused by diffraction of waves from all points of the *rim* of this hole so that in the plane I_1-I_2 , where the lens has produced an image of the luminous point P_1 at P_2 , we still find a diffraction disc of a definite determinable diameter surrounded by ring-shaped interference maxima and minima.

CIRCLE OF CONFUSION AND DIFFRACTION DISC

We may now remember that at the beginning of this article we explained that due to small amounts of spherical aberration in the lens, the image of a point was a circle of confusion of definite diameter. The size of this circle of confusion could be reduced through the skill of the lens maker, and now we again face the fact that the image of a point produced by a lens is a disc of definite diameter, but it must be emphasized that this second disc, which is *not a circle of confusion, but a diffraction disc*, is produced by light diffractions, and we cannot eliminate the effect of these diffractions by any special tricks in making lenses. In other words, even in a theoretically perfect lens for which the circle of confusion is practically reduced to a point, we have to contend with the diffrac-

CIRCLE OF CONFUSION AND DIFFRACTION DISC

tion of light waves which produce these circles of definite diameter as images of single object points and therefore limit the capacity of the lens to reproduce fine detail. This capacity, incidentally, is also called the *physical resolving power* (as distinguished from photographic resolving power) of the lens, and we have now come to the conclusion that the *physical resolving power of lenses is limited due to the fact that light produces certain diffraction phenomena.*

RELATION BETWEEN DIFFRACTION DISC AND F-VALUE

There only remains for us the task of investigating the relation between the diameter of the diffraction disc and the diameter of the lens, as well as the distance between the lens and the plane where the image is formed. The geometrical conditions are shown in Figure 11, in which it has been assumed that the luminous point is very far away from the lens (for instance, a star which is millions of miles away). The rays are now entering the lens practically parallel to each other. If the object is at infinity, the image is formed in the focal plane of the lens so that the distance from the lens to the plane I_1 - I_2 is equal

to the focal length. For those who are mathematically inclined, the following equations may be of interest:

$$\text{In } \triangle M_1C_1B: M_1C_1 = \sqrt{(R+r)^2 + F^2}$$

$$\text{In } \triangle BC_1M_2: M_2C_1 = \sqrt{(R-r)^2 + F^2}$$

At point C_1 , an interference minimum occurs therefore:

$$M_1C_1 = M_2C_1 + 1.22 \times l$$

$$\sqrt{(R+r)^2 + F^2} = \sqrt{(R-r)^2 + F^2} + 1.22 \times l$$

Solving this last equation for r we obtain:

$$r = 1.22 \times l \times \sqrt{\frac{4F^2 - 1.22^2 \times l^2}{4(R^2 + 1.22^2 \times l^2)}}$$

In comparison to F (focal length of lens) and $2R$ (diameter of lens), the factor $1.22^2 \times l^2$ is very small, since the average wave length of light l is about .00055mm, and

$$l^2 = 0.0000003025 \text{ mm}$$

Therefore, in the last equation we can readily neglect the factors $1.22^2 \times l^2$ and we obtain for r the *radius* of the diffraction disc,

$$r = 1.22 \times l \times \frac{F}{2R}$$

It is customary to express the *diameter* $2r$ (instead of the radius r) of the diffraction disc as a function of the *f-value* of the lens instead of its diameter and focal length. With

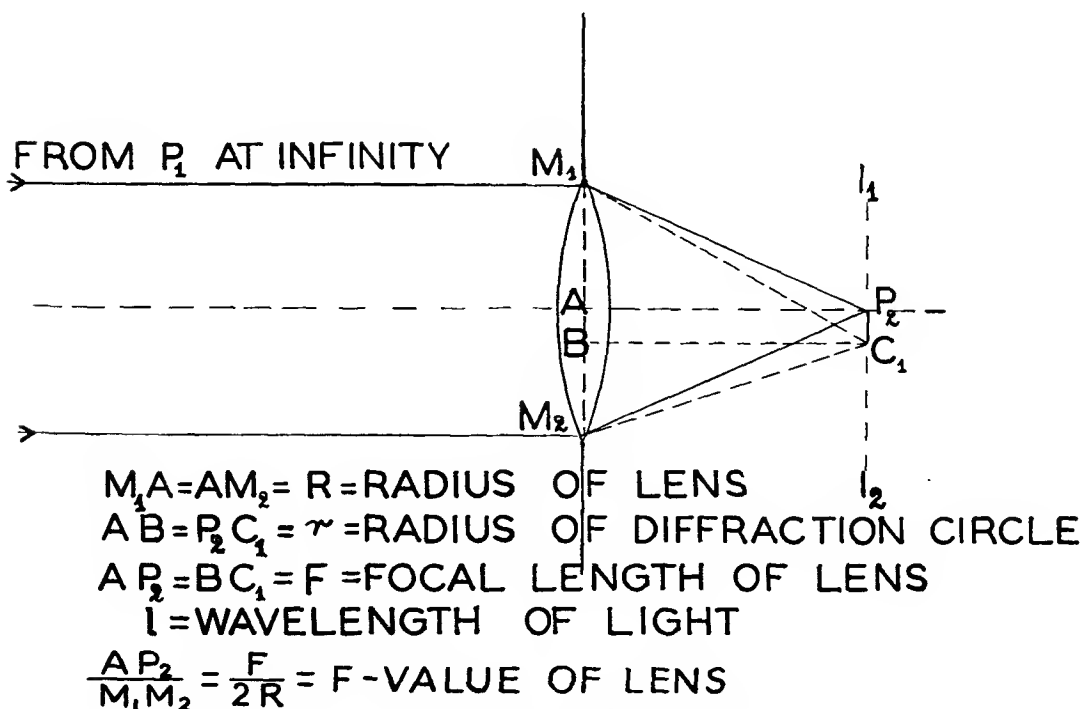


FIG. 11. RELATION OF DISC TO F-VALUE

reference to the explanations of the symbols at the bottom of Figure 11, we therefore obtain

$$2r = 2 \times 1.22 \times l \times f$$

The diameter of the diffraction disc is the same for all theoretically perfect lenses of the same f-value regardless of the focal length of the lens.

The actual diameters of the diffraction discs for various f-values are given here below (for green light of a wave length of 0.00055mm):

F-Value:	1.5	2.5	3.5	4.5
Diameter				
of Diffraction Disc:	0.0020	0.0034	0.0047	0.0060
	mm	mm	mm	mm
F-Value:	6.3	9	12.5	18
Diameter				
of Diffraction Disc:	0.0085	0.0121	0.0168	0.0242
	mm	mm	mm	mm

These figures show very definitely that a theoretically perfect lens forms the sharpest image when the diaphragm is *wide open* and the light transmitting capacity is at its highest. This fact also shows how important it is for the lens designer and manufacturer to try his utmost to overcome spherical aberration and to make the circle of confusion as small as possible. Up to a certain f-value, the manufacturers have been successful in holding the size of the circle of confusion below that of the diffraction disc. We may therefore say that the best test for the quality of a lens is to find out how far the iris diaphragm can be opened while still producing a beneficial effect upon the sharpness of the image.*

RESOLVING POWER

The following example may illustrate the practical significance of the physical resolving power. Let us assume that a lens of 50mm is used at f/12.5 to photograph two luminous points 1mm apart and 6050mm away from the lens. We are using a good lens where the circle of confusion at f/12.5 is smaller than the diffraction disc. Accord-

ing to a well-known formula,** the ratio of reduction of this lens for this distance is 120:1. Therefore, in the image the distance from center to center of the two diffraction discs is 1/120mm or 0.0083mm, but the diameter of each circle of diffraction is 0.0168mm so that the two circles overlap, and it is impossible to reproduce each point as a separate unit.

By opening the iris diaphragm of the lens to f/2.8 but leaving all other conditions as before, the diameters of the diffraction discs have been reduced to 0.0038mm, whereas, of course, the ratio of reduction of the lens system has remained the same. Therefore, also the distance from center to center of the diffraction circles has remained the same, viz. 0.0083mm. In other words, the physical resolving power of the lens has increased so that we see two separate images of the two individual object points, provided that the circle of confusion of this lens at an f-value of 2.8 is still smaller than the diffraction disc. This is a rather theoretical approach to the problem, however.

A more realistic example, which does not require any experimental equipment, can be conducted by everybody at night when the sky is clear and the stars are visible. We see numerous individual stars which are reproduced by the lens of the eye as individual diffraction discs on the retina of the eye. But we also perceive in the sky the Milky Way as a long, foggy area. Actually, in this area there are also numerous individual stars but in the image on the retina the diffraction discs are so close together that they overlap and we only see one foggy area. If we take a telescope which magnifies in the image the distance from one diffraction disc to the other, we see that the Milky Way actually consists of a great multitude of individual stars.

** $\frac{0}{I} = \frac{D_o - F}{F}$, when 0 is the size of the object

I is the size of the image
D_o is the distance from object to lens (6050mm)
F is the focal length of the lens (50mm)
0 is the ratio of reduction

$\frac{120}{I} = \frac{6050\text{mm} - 50\text{mm}}{50\text{mm}}$

*A few words of caution are advisable for those who want to conduct such experiments. It is often unexpectedly difficult in experiments to eliminate the influences of other variable factors. Nothing is more disastrous than jumping at conclusions in face of incomplete results of superficially conducted experiments.

SHARPNESS OF THE RECORDED IMAGE

We have now arrived at the end of our explanation concerning the circle of confusion and the diffraction disc, as well as the influence of these upon the sharpness of the image *which the lens has formed*. At this point we must add a few remarks regarding the process of recording this image on the negative, because in this process some of the detail of the image as formed by the lens is lost.

The emulsion on the film is a layer of definite thickness. Although this film of light-sensitive emulsion is thinner than a sheet of paper, it is still considerably thicker than the wave lengths of light. Furthermore, this emulsion is turbid so that the light which may have been concentrated upon the surface into a very sharp image, scatters again as it penetrates into this turbid emulsion, and thus a certain amount of the detail is obliterated. Another fact which we have to consider is that the emulsion consists of individual grains of silver bromide of a certain magnitude, and in the process of development these are converted into clusters of silver grains. This has an influence upon the sharpness of the recorded image. Then we must remember that the film or plate with its emulsion is not absolutely optically flat. There are numerous other factors which influence the sharpness of the *recorded* image—the contrast in the object, the contrast in the negative (gamma), the time of exposure, the type of developer used, etc. (See K. Huse, "Photographic Resolving Power," *Journal of The Optical Society of America*, I (1917) pp.119-133.) It is practically impossible to analyze quantitatively the influence of each single factor, but a few general remarks may be of practical value.

F-VALUE AND SHARPNESS

Let us investigate the manner in which the f-value of the lens at which the photo was taken influences the sharpness of the *recorded* image. We have seen that the image which a *good lens* forms is *gaining* in sharpness as we open the iris diaphragm. On the other hand, it seems definitely established that the *recorded* image *loses* in sharpness as we fully open the iris diaphragm of a

modern ultraspeed lens. To understand this, we must remember that with the iris diaphragm open, the rays which form the image of one single point enclose quite a wide angle. From the plane of greatest sharpness where the rays intersect, they *diverge* quite rapidly as they pass through the light sensitive layer of the emulsion which has a certain thickness and turbidity. Therefore a considerable number of silver bromide grains, *outside* of the area of the actual diffraction disc as focused on the *surface* of the emulsion, are exposed to light. In other words, with the iris diaphragm open, the discrepancy between the sharpness of the image *as formed* and *as recorded* on the negative is most pronounced. As we close the iris diaphragm, the angle produced by the image-forming rays coming from one object point decreases so that with the iris diaphragm closed to a considerable degree, the discrepancy between the sharpness of the image *as formed* by the lens and its *record* on the negative is relatively small. Thus in practice we can benefit very little from the possibility of a *sharper* image by opening the iris diaphragm, since we are apt to lose this sharpness in the process of recording the image. The capacity of the photographic process to record fine detail in the image is also called *the photographic resolving power* as distinguished from the physical resolving power which was mentioned before.

We have mentioned that at $f/18$ the diffraction disc is about 0.03mm, and this value can readily be accepted as the practical limit of the sharpness of the recorded image under *average* conditions for almost every aperture of the lens and throughout the area of the negative. Under extremely favorable conditions (an ultra fine grain film of very low sensitivity, light of a short wave length, good contrast in the object, correct exposure, best development, etc.) we can produce sharper negatives so that under these special conditions we can also benefit by the increase in sharpness when we open the iris diaphragm (provided we have a well corrected lens). But for general purposes, we may accept an average of 0.03mm as the limit of sharpness *in the negative* regardless of the f-value.

THE COMPLETE PHOTOGRAPHER

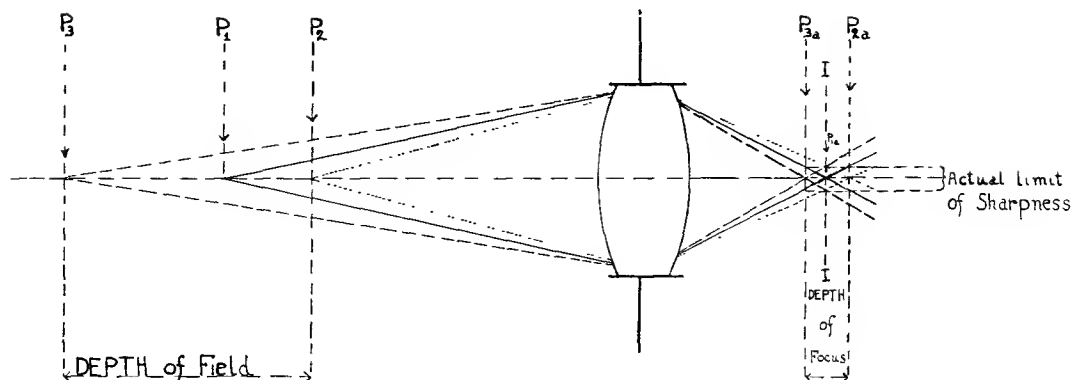


FIG. 12. DEPTH OF FIELD AND DEPTH OF FOCUS

DEPTH OF FOCUS, DEPTH OF FIELD, AND LIMIT OF SHARPNESS

At long last, it is advisable to draw attention to another aspect of the problem of the limited sharpness of the image. It is interesting to note that because there is a limit of the sharpness in the image, we shall see in the photograph that objects which are nearer to the lens than others will appear equally sharp. The non-existent but temporarily assumed condition of unlimited sharpness of the image was illustrated in Figure 2 of this article. If these conditions did really exist, and if we moved a ground-glass or projection screen gradually away from the lens in the image space (Figure 2) we would be able to find one definite distance from the lens to the screen where all rays coming from the object point P_1 had not yet been united to a true point, but where they were concentrated into a circular area of a certain diameter, for instance 0.03mm. By moving the screen a very small distance farther away from the lens, they would have been united in a true point, and if from that position we would have moved the screen still slightly farther away from the lens, the rays would diverge, and there would be still another distance between screen and lens where the rays from the same object point P_1 would again cover a circular space of the above mentioned diameter of 0.03mm. Since actually the image will never be sharper than 0.03mm, we may place the screen at the first or at the last distance where the image had this degree of practically optimum sharpness, and in both cases point

P_1 will be photographically recorded with optimum sharpness. Of course, the same applies for all distances between these two extreme limits. Therefore, the difference between these two extreme *image distances* where in reality maximum sharpness prevails, has been called the *depth of focus*.

But if we would place the screen (or the negative) at that distance from the lens where *theoretically* ideal sharpness prevails for the image of one object point P_1 as shown in Figure 12, we could photograph *in reality* object points nearer to and farther from the lens than point P_1 with the same degree of practically obtainable maximum sharpness. For instance, point P_2 in Figure 12 is closer to the lens. In the plane $I-I$ its image is a circle of the same diameter of the practical limit of sharpness. The theoretically perfect image of this point P_2 is formed slightly farther away from the lens at P_{2a} . On the other hand, there is an object point P_3 farther away from the lens. Its theoretically perfect image is formed closer to the lens at P_{3a} , but in the plane $I-I$ the rays have diverged slightly so that they just cover a circular area of the diameter representing the practical limit of sharpness. Thus, in reality, all points within the range of object distances between P_2 and P_3 appear in the photograph with equal and maximum obtainable sharpness. This range of *object distances* for which in the image maximum obtainable sharpness prevails, is called the *depth of field*.

Some manufacturers have provided the focusing mounts of their photographic objectives with special markings indicating the

CLOSE-UPS AND LONG SHOTS

ranges of depth of field for various f-values. These markings are often called "depth of focus scale," a term which, on the basis of the definitions given above, is not quite correct (because it should be called depth of field scale), but probably due to lack of standardization of terms by the manufacturers.

The entire problem of depth of field and depth of focus will require treatment in another article (see article on *Lens Characteristics*). At present, we are mainly interested in its relation to the limit of sharpness. It is quite evident that the *greater* the sharpness, the *smaller* the range of depth of field. Stories about lenses of the same focal length and f-value as other lenses producing *sharper* pictures with *greater* range of depth of field, should only be told in a Tall Story Club.

The actual depth of field of a lens as recorded in a photograph depends upon the same multitude of factors as the photographic resolving power itself. The depth of field scales on the focusing mounts of photographic objectives of various manufacturers are based on certain arbitrarily *fixed values* for the photographic resolving power (actual limit of sharpness)—for instance 0.03mm. But since the manufacturers among themselves have not agreed on the acceptance of one standard value, it is not feasible to compare the actual values for the depth of field of the lenses of different makes for identical focal lengths and f-values as recorded on the scales, and to draw conclusions about the quality of the lenses from such comparisons.

Altogether, it is really remarkable that a value of the magnitude of 0.03mm could be accepted as the *average* limit of the photographic resolving power. After all, there is also a limit of the resolving power of the lens in the human eye. It has been definitely established that the limit of resolving power of the human eye is such that in objects which are approximately 10 inches away from the eye the finest detail which is still distinguishable must have a magnitude of approximately 0.01 to 0.005 inch (depending upon the individual eyesight). If the finest detail in the negative is as small as 0.03mm or 0.00125 inch, it is evident that from such negatives we can produce en-

largements at magnifications of at least 4 to 8 times and still obtain prints which, when viewed from a distance of about 10 inches, appear at maximum sharpness to the human eye.

CLOSE-UPS AND LONG SHOTS

Lewis Jacobs

Author of The Rise of the American Film and Film Writing Forms; Founding Editor of Experimental Cinema; Member of Screen Writers Guild

In motion picture work and with the still picture series, the proper use of close-ups and long shots is important—both technically and psychologically. The author, who has worked with and studied movies of all kinds, including the experimental and the documentary, has a good deal to say about the meaning of the close-up and long shot, as well as something on the techniques involved.

See Also Angle Shots, Angle Shots on the Screen

ALL too frequently the average photographer, both still and motion picture, fails to utilize the space distances between himself and his principal subject. Most photographers snap their pictures from some vague middle distance, not too near, not too far, then wonder at the dull results. What these photographers have not yet realized is that the closeness or distance of the camera to the subject, commonly designated as the close-up or long shot, offers a rich source of pictorial effects.

In the close-up and long shot, the photographer can discover and reveal many unusual and striking aspects of the subject in a most individual style. An awareness of the possibilities inherent in the expressiveness of the close-up and long shot often means the difference between an ordinary picture and a distinctive one.

In the days before miniature photography and amateur movie making, only pictures of complete objects or persons were photographed. Every photograph was a long shot, taken from the position of a spectator watching a play. Close-ups of a detail within the whole—a foot, a hand, part of a face—could have been photographed, but for the most part they were not. The exceptions were the portrait photographers who thought of a picture as a portrait bust or portrait group,

and not as a close-up or long shot. In practically all other types of photography, including movie, a picture included the entire person, object, or scene. The margins and shape of the photograph were considered only to make certain nothing was cut off the person, object, or scene photographed. In general the cameraman's concern was with reproducing the subject matter and not at all with the manner in which the subject matter could be made interesting.

That a subject could be made interesting or dramatic by reason of its presentation rather than by its content alone entailed an intellectual process on the part of the photographer similar to the thinking which artists in other media of expression underwent before they could become creative. Eventually, however, the photographer did realize that the camera need not be restricted to one viewpoint or its role limited to that of a passive observer at a play. It gradually became evident, notably in the photographs of Stieglitz, Steichen, Sheeler, Strand, and the movies of Griffith and his contemporaries, that if the camera was given the freedom and curiosity of an active observer who roamed about intelligently, the subject matter before the lens would gain in meaning, effectiveness, and importance. The cameraman learned that by altering the distance and viewpoint of his shots, he could control and intensify their power. If he came very close to the subject, his camera discovered details never revealed otherwise; if he placed his camera at a more remote distance, larger aspects were revealed. Out of this discovery arose the concepts of close-up, medium shot, and long shot—each designating the camera's proximity to the subject.

RELATIVE DISTANCE

How near is a close-up? How far is a long shot? No two cameramen will agree as to the exact distance of each. All, however, will agree as to the constancy in the relationships of these shot distances to one another. For far and near are, of course, relative terms. What might be a sufficient distance for taking a long shot of one subject might be near enough to result in a close shot of another subject. For instance, a long shot of an infant could be taken from a distance of

approximately ten feet and a close-up from as near as one foot. Yet if the Empire State Building were photographed at a distance of ten feet, it would not be a long shot but a close-up, for the photograph of the building taken from that distance would reveal only a small detail. To get a long shot of the Empire State Building, it might be necessary to get almost a mile away from it. This explains why many photographers so often believe they have taken a close-up of a subject when actually their picture shows a long shot and vice versa.

If distance, then, is not always the deciding factor in achieving the close-up and long shot, what is? The point to remember is not how many feet away from the subject the camera must be to get a close-up or long shot, but how much of the subject is to be revealed in the shot. *A close-up eliminates everything but one feature of the subject; a long shot includes the whole of the subject.* Once this definition is understood, the problem of making more arresting pictures through the use of close and long shots is half solved, for the cameraman has learned to think of his camera as a creative tool, instead of a mechanical one.

FUNCTION OF CLOSE-UP AND LONG SHOT

The technic of close-ups is undoubtedly one of the most exciting contributions to modern photography. By it, the cameraman is able to convey facts so clearly, so dramatically, that the slowest minds cannot fail to grasp them. Proof of its popularity and effectiveness can be found on the advertising pages of every magazine and on the screens of every motion picture theater. The cameraman should try to use as many as possible. They bring the picture to life.

The chief function of the close-up is to particularize; the chief function of the long shot is to generalize. The close-up, in excluding unwanted portions of the subject, focuses attention only on what is important and makes that clearer through magnification. The long shot, by including all of the subject, focuses attention upon its broader aspects and makes that clearer through reduction. In addition, the distortion in size that results from the close-up and long shot,

CLOSE-UPS AND LONG SHOTS

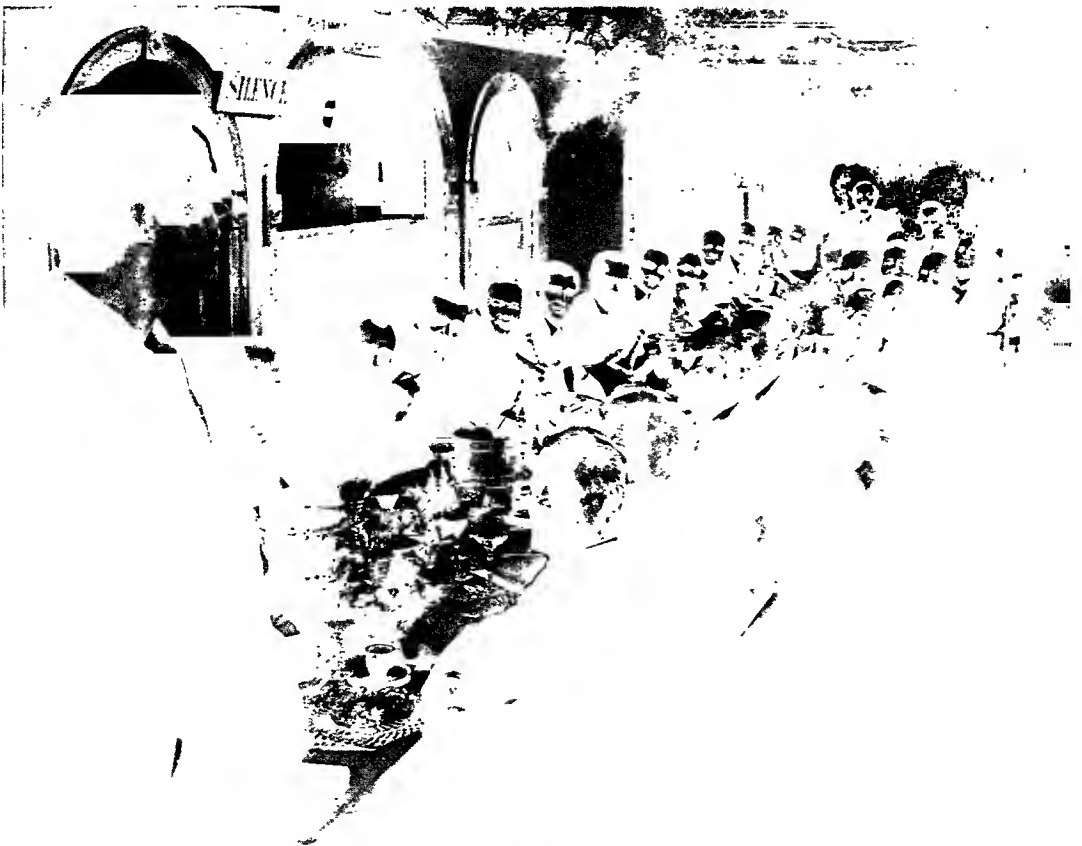
creates a difference in dramatic emphasis, enabling the photographer to play one against the other. It is the close-up which is the cameraman's real attention getter; the long shot serves to define or point out the subject as a whole.

When and how to use close-ups and long shots depends, of course, upon the subject matter and what the cameraman wants to say. Each subject requires its own treatment; nevertheless there are certain principles that hold true for the use of close-ups and long shots in both still and motion picture photography. A knowledge of these principles is the surest way for the average cameraman to improve his technic and is an assurance of distinguished picture making. The principles discussed here are by no means exhaustive; they are offered as a stimulus and foundation only.

The problem of the close-up and long shot is one of qualitative as well as quantitative selection. The cameraman must choose close-ups not only of those portions of the subject which are typical of the whole, but also those which are typical of the best parts of the whole. He must also be on the lookout for long shots which not only reveal all of his subject, but which reveal it from the best vantage points. Only in this way can the salient features of a subject be rendered adequately and excitingly; only in this way lies creative photography.

TECHNIC OF CLOSE-UPS AND LONG SHOTS

In addition to the qualitative aspect, there are also the technical and mechanical factors of making close-ups and long shots which should be discussed.



DEPTH OF FIELD. It is, of course, possible to combine the close-up and the long or medium shot in one picture, making both important. In such pictures as *Citizen Kane*, shown here, the hero constitutes the close-up (the embroidery on his collar is even clear) and the other principals are shown at the extreme end—with the men gathered at the banquet table forming a link
Photo, RKO Pictures

THE COMPLETE PHOTOGRAPHER



LONG SHOT FOR RAPID ACTION. Anything less than a long shot constrains the amount of movement, concentrates action, and restricts the number of people in a shot, simply because the shooting area is smaller. The closer the subject is to the camera, the less of it will be seen. And conversely the farther away the subject is from the camera, the more of it will be included. Sports of any kind—football, horse racing, or baseball, or any one which takes a wide area and has fast action—must be shot in the long shot if the complete action is to be clear and followed.

Take this World Series photograph of a double play, for instance. In order to understand that there has been a double play, you have to see at least two bases (in this case, first and second) and you have to see at least four men—the two runners and the two basemen. Henrich of the Yankees is shown sliding into second base amid a cloud of dirt and Joe Di Maggio, the hitter, is shown reaching first. At the same time we see Herman of the Dodgers who has just thrown the ball from second and is in the act of falling down, having been upset by the sliding base runner. Meantime, Camilli (No. 4) is catching the ball at first, his foot on the bag. And included in the picture, too, is the Yankee first base coach, watching the whole thing happen. This remarkable shot was taken from behind first base with a 66

Bertha camera

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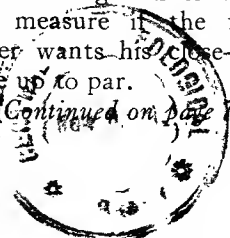
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Exposure varies with the subject matter, light conditions, time of day, locale, reflections, etc., consequently it would be impossible to prescribe exposure data for close-ups and long shots. The exposure meter is the safest guide the film maker can use in this respect. However there is a general rule which may be of some help. That is, open the lens 3 stops more for a close-up than for a long shot.

In the matter of lenses remember to use a longer focal length lens for a close-up than for a long shot. There are two reasons for this. First, the most popular use of lenses of different focal lengths is to span distance. As you increase the focal length of the lens, the size of the field of view narrows down. A 2-inch lens would thus halve the height and width of an area covered by a 1-inch lens. The second reason for the use of a longer focal length lens in the close-up is that more modeling and roundness is achieved with longer focal length lenses than is obtained with shorter ones.

Focusing is an important matter in shooting the close-up. The longer focal length lens and larger opening used for close-ups, makes the depth of field shallow. Thus a slight error in focusing will destroy the sharpness and definition of a subject in close-up. It is therefore advisable to use either a range finder or a tape measure if the film maker wants his close-ups to be up to par.

(Continued on page 785)





11.3.

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